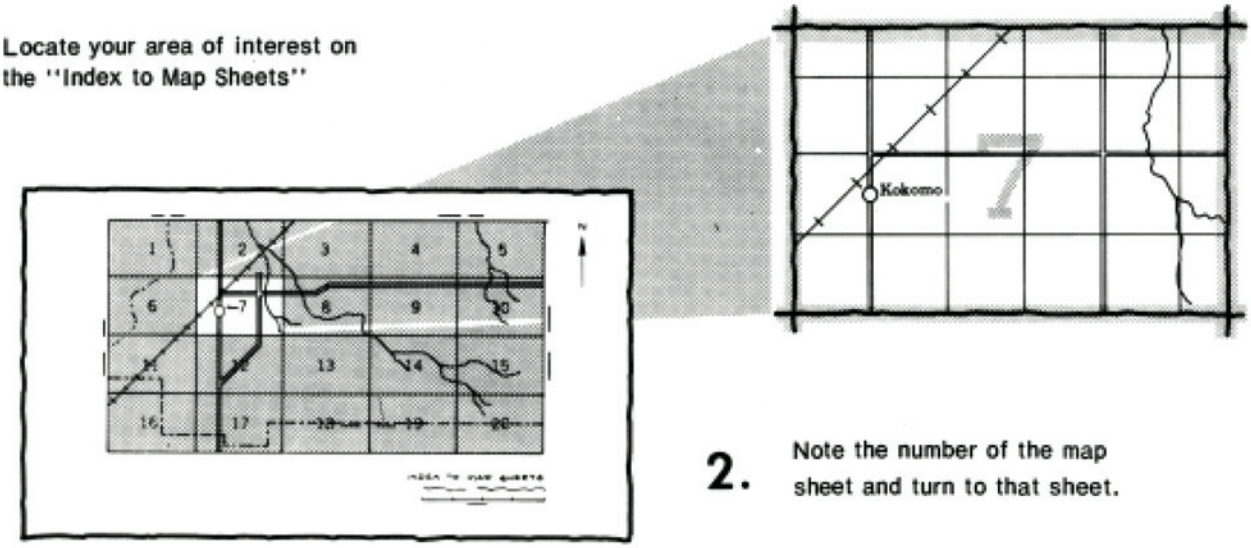
soil survey of

# Roberts County Texas

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

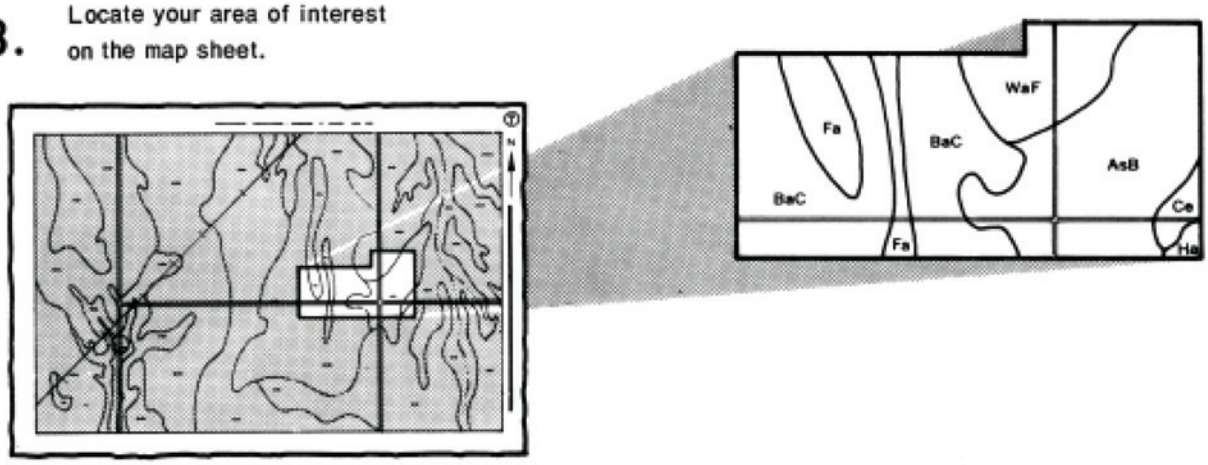
# HOW TO USE

**1.** Locate your area of interest on the "Index to Map Sheets"

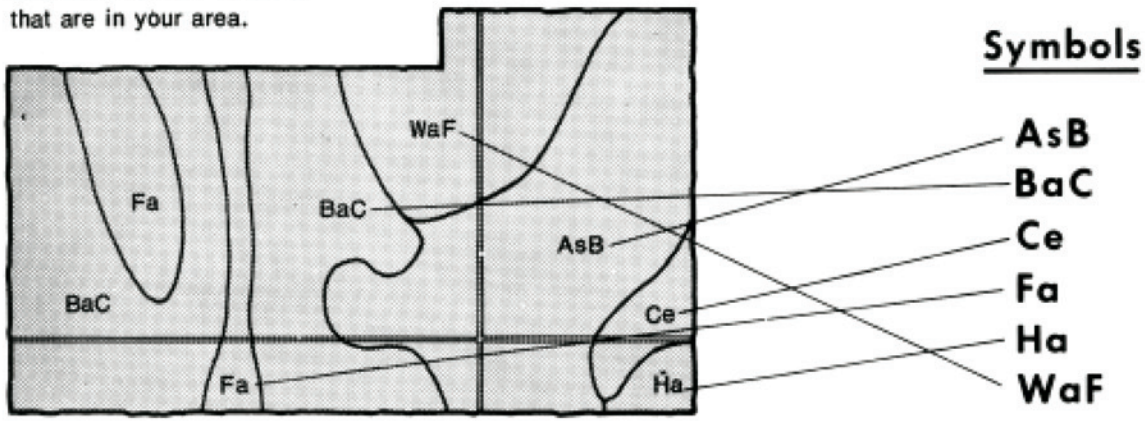



**2.** Note the number of the map sheet and turn to that sheet.

**3.** Locate your area of interest on the map sheet.

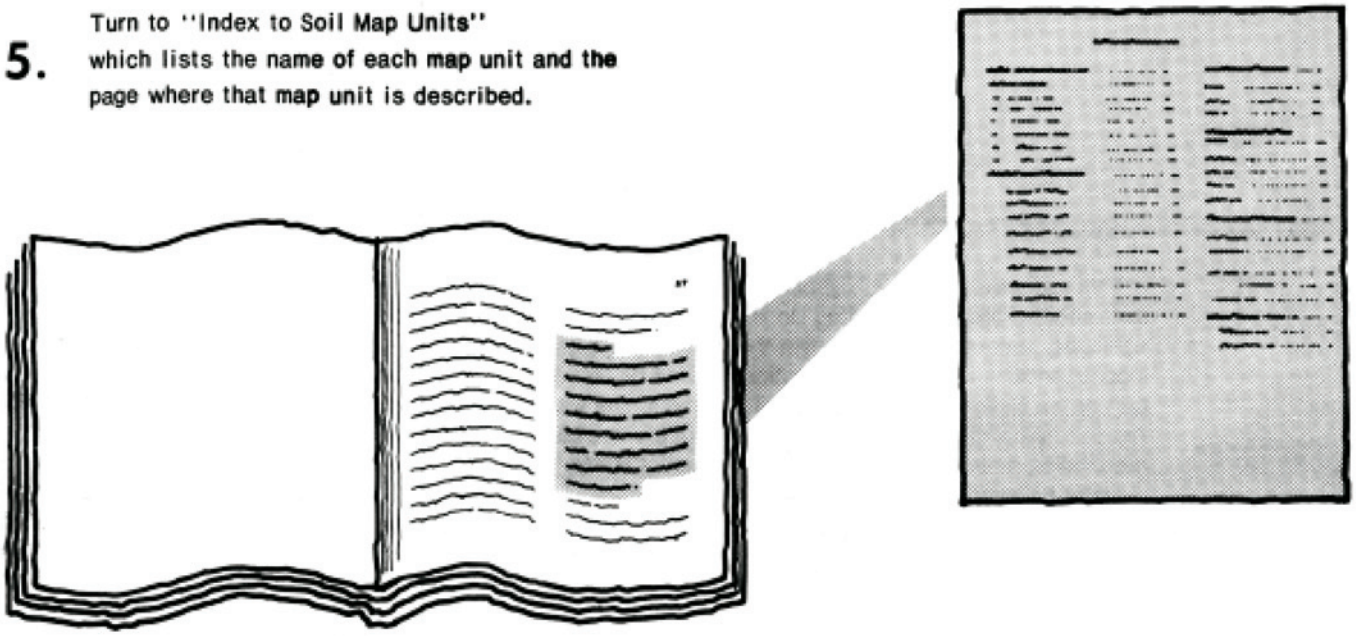



**4.** List the map unit symbols that are in your area.

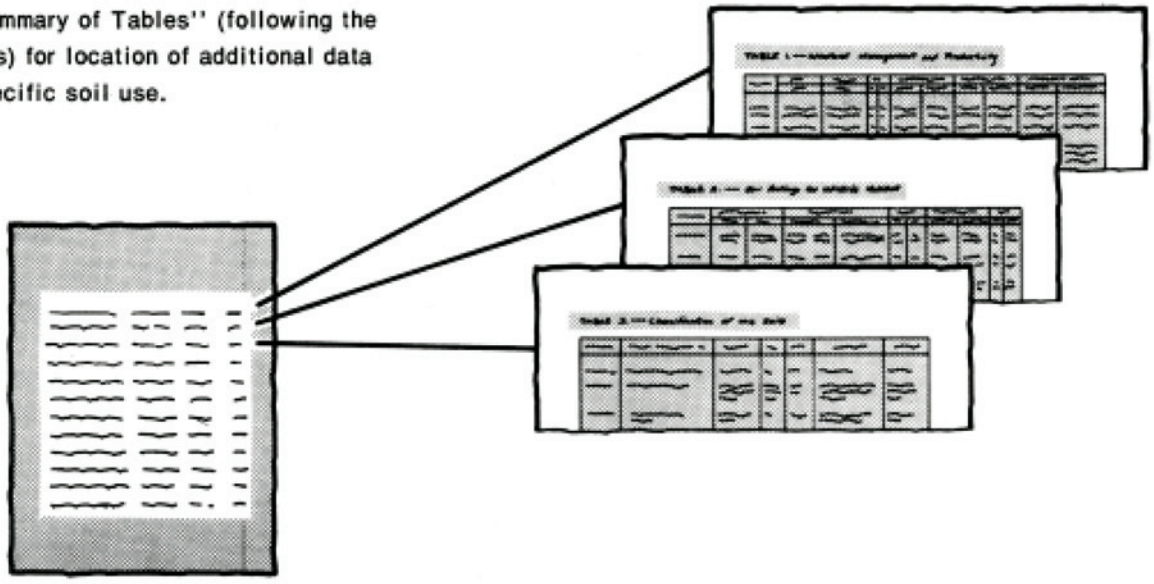


# THIS SOIL SURVEY

**5.** Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



**6.** See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



**7.** Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1959-1978. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Roberts County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

# contents



## soil series



Issued September 1981

# index to soil map units

# summary of tables

# foreword

This soil survey contains information that can be used in land-planning programs in Roberts County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

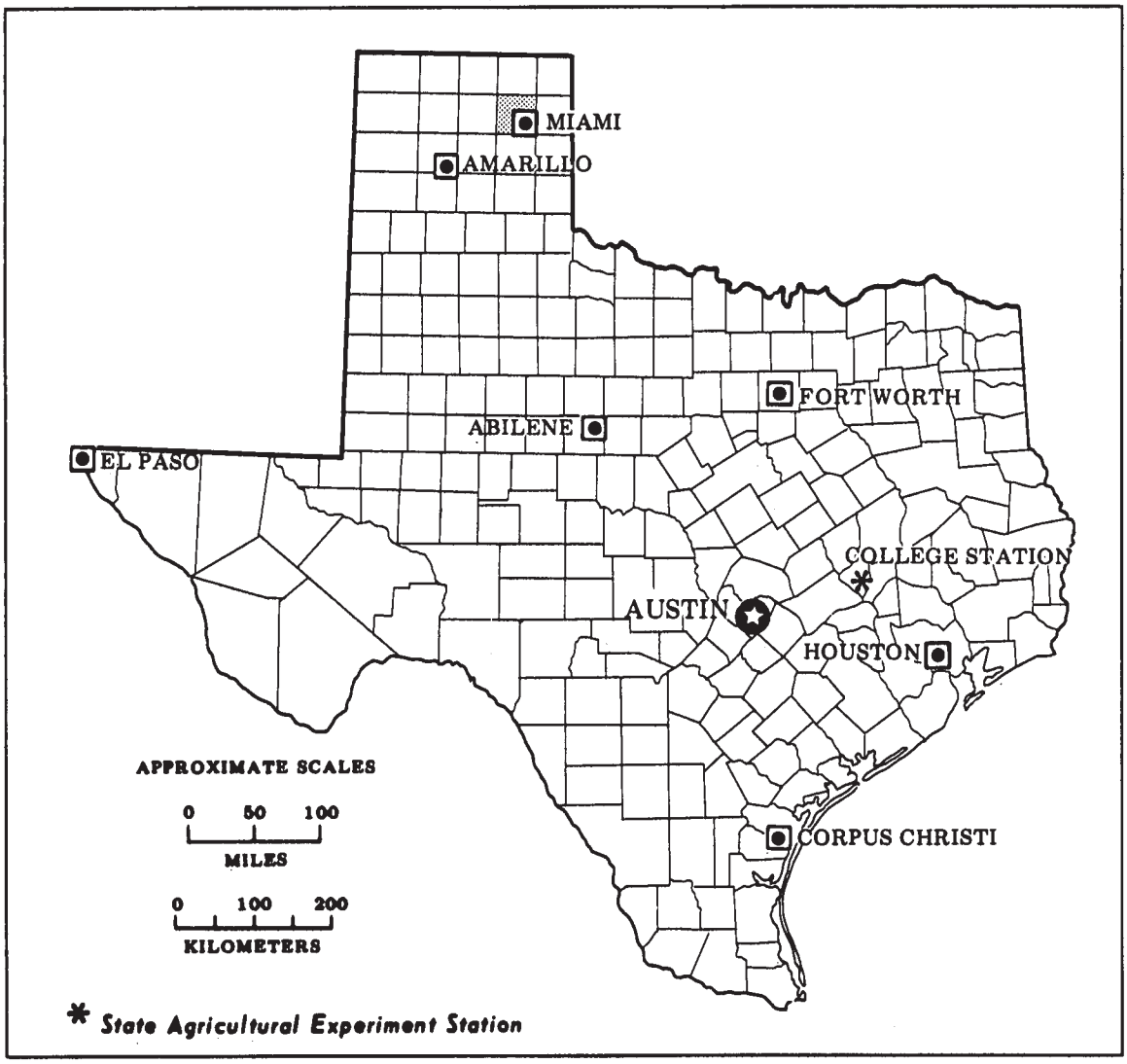
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil.

Descriptions, names, and boundaries of the soils in this survey do not fully agree with those on soil maps for adjacent counties. The differences are the result of better knowledge of soils, modifications of series concepts, the intensity of mapping, or the extent of the soils within the survey area. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks
State Conservationist
Soil Conservation Service




*Location of Roberts County in Texas.*

# soil survey of
# Roberts County, Texas

by Jim C. Wyrick, Soil Conservation Service

Soils surveyed by Jim C. Wyrick and Jack C. Williams
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
the Texas Agricultural Experiment Station

ROBERTS COUNTY is in the Canadian River Valley in the eastern part of the Texas Panhandle. It is about 30 miles square and covers 588,800 acres, or 920 square miles. The topography is mostly rolling with some nearly level and steep areas. The Canadian River cuts across the northern part of the county. Elevation ranges from 2,300 feet in the Canadian River bottom to 3,275 feet in the southern part of the county.

In 1979, the county had a population of 1,043. Miami, population 728, is the county seat. It is located in the southeast corner of the county, along Red Deer Creek. Miami is served by a railroad line and U.S. Highway 60.

## general nature of the county

This section provides general information about Roberts County. It briefly describes the history, agriculture, natural resources, and climate.

### history

Roberts County was created from the Young Territory in 1876, but was not organized until 1889. The county was named after John S. Roberts, one of the original advocates of Texas independence, and Oran M. Roberts, former governor of Texas.

The Santa Fe Railroad was constructed through the county about 1887, and the county began to be settled. The first settlers were ranchers, and the county has continued to be primarily ranching country. Little of the county was cropped until the early 1920's.

The original vegetation on the loamy soils was mainly sideoats grama and blue grama grass; on the steep and broken areas it was mostly sideoats grama and little bluestem. The bottom lands and sandy areas were originally covered by tall grasses such as switchgrass, sand bluestem, indiangrass, and little bluestem.

Game birds such as quail, dove, and turkey were common. Wild animals such as buffalo, deer, antelope, prairie dog, and rabbits were plentiful. Fish were in most of the larger streams.

### agriculture

The total area of Roberts County is 588,800 acres. Of this, 4,200 acres is urban or built-up areas, and 5,440 acres are bodies of water less than 40 acres in size. Most of the water acreage is in the Canadian River channel. Approximately 517,000 acres is rangeland, and 53,000 acres is cropland (*3*).

According to records of the local field office of the Soil Conservation Service, about 9,600 acres of the cropland is in grain sorghum, of which 7,600 acres is irrigated. About 29,000 acres is in wheat, of which 9,300 acres is irrigated. Most farm income is made on cattle, grain sorghum, and wheat.

### natural resources

The soil is the most important natural resource in Roberts County. It produces crops and provides range for livestock.

Water, particularly ground water, is also important. The largest amount of water used is for irrigation in the nearly level area in the southern part of the county where the water is soft and of good quality. In the more sloping areas, which are used principally for rangeland, the water is good but there is less of it. There is, however,

sufficient water for livestock. Most of it is pumped by windmills.

Roberts County is in a rich oil- and gas-producing region. Many wells have been brought into production, and the search for more wells continues. The oil and gas industry has increased the income of many county residents by paying royalties and providing employment.

The county has many deposits of caliche that are excavated for road surfacing and other construction work.

### climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Winter weather in Roberts County is alternately mild and very cool. Cold fronts repeatedly sweep over the area, causing sharp drops in temperature, but the cold air behind these fronts moderates quickly. Summers are hot.

Table 1 gives data on temperature and precipitation for the county as recorded at Miami, Texas, in the period 1951 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 37 degrees F, and the average daily minimum temperature is 22 degrees. The lowest temperature on record, which occurred at Miami on January 4, 1959, is -13 degrees. In summer the average temperature is 78 degrees, and the average daily maximum temperature is 92 degrees. The highest recorded temperature, which occurred at Miami on July 11,1970, is 111 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 21 inches, which is usually enough for wheat, sorghum, and range grasses. Of this, 15 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 4.35 inches at Miami on May 16, 1951. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 15 inches. The greatest snow depth at any one time during the period of record was 21 inches. On an average of 5 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 15 miles per hour, in spring.

Duststorms occur occasionally in late winter and in spring. Tornadoes and severe thunderstorms, some with hail, occur now and then in the spring and in summer.

## how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

# general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their suitability for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the suitability of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil suitability ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, rangeland, urban uses,* and *recreation areas*. Cultivated crops are those grown extensively in the survey area. Rangeland is land on which the native vegetation is predominantly grasses, forbs, or shrubs suitable for grazing or browsing by livestock. Urban uses include residential, commercial, and industrial developments. Recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

## soil descriptions

### 1. Mobeetie-Potter-Berda

*Deep and very shallow, gently sloping to steep, moderately and moderately rapidly permeable, loamy soils; on uplands*

Soils in this map unit formed in loamy, calcareous sediment and beds of caliche.

This unit covers about 41 percent of the county. Mobeetie soils make up about 33 percent of the unit, Potter soils about 23 percent, and Berda soils about 10 percent. Other soils make up the rest (fig. 1).

The Mobeetie soils are on the mid and lower slopes. Typically, they are brownish, calcareous, moderately alkaline fine sandy loam to a depth of about 80 inches.

The Potter soils are on the steeper areas of the upper slopes. Typically, the surface layer is about 9 inches thick. It is brownish loam in the upper few inches and brownish gravelly loam in the lower part. Under this is pink, platy caliche.

The Berda soils are on the mid and upper slopes. Typically, the surface layer is brown loam about 10 inches thick. The upper part of the subsoil, to a depth of about 24 inches, is brownish sandy clay loam. The lower part of the subsoil and the underlying layer, to below a depth of 80 inches, is pink sandy clay loam. The soil is calcareous and moderately alkaline throughout.

The other soils in this unit are the moderately permeable Amarillo, Estacado, Bippus, Guadalupe, Paloduro, Spur, and Veal soils; the moderately slowly permeable Olton soils; and the moderately rapidly permeable Guadalupe and Likes soils.

This unit is predominantly rangeland. Low rainfall, high contents of calcium carbonate, rapid runoff, and low available water capacity are limitations.

This unit is poorly suited to crops. Limitations are the slope, the hazard of erosion, and the shallow depth to caliche in the Potter soils. This unit is moderately well suited to range. It is moderately well suited to urban and recreation uses. Slope and the shallow depth to rock, in some places, are limitations.

### 2. Estacado-Paloduro

*Deep, nearly level to rolling, moderately permeable, loamy soils; on uplands*

Soils in this map unit formed in ancient alluvial and eolian sediment.

This unit covers about 23 percent of the county. Estacado soils make up about 53 percent of the unit, and Paloduro soils about 35 percent. Other soils make up the rest.

The Estacado soils are on the mid and upper slopes. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The subsoil, to a depth of 80 inches, is a clay loam that is brownish in the upper part and reddish yellow in the lower part. The soil is calcareous and moderately alkaline throughout.

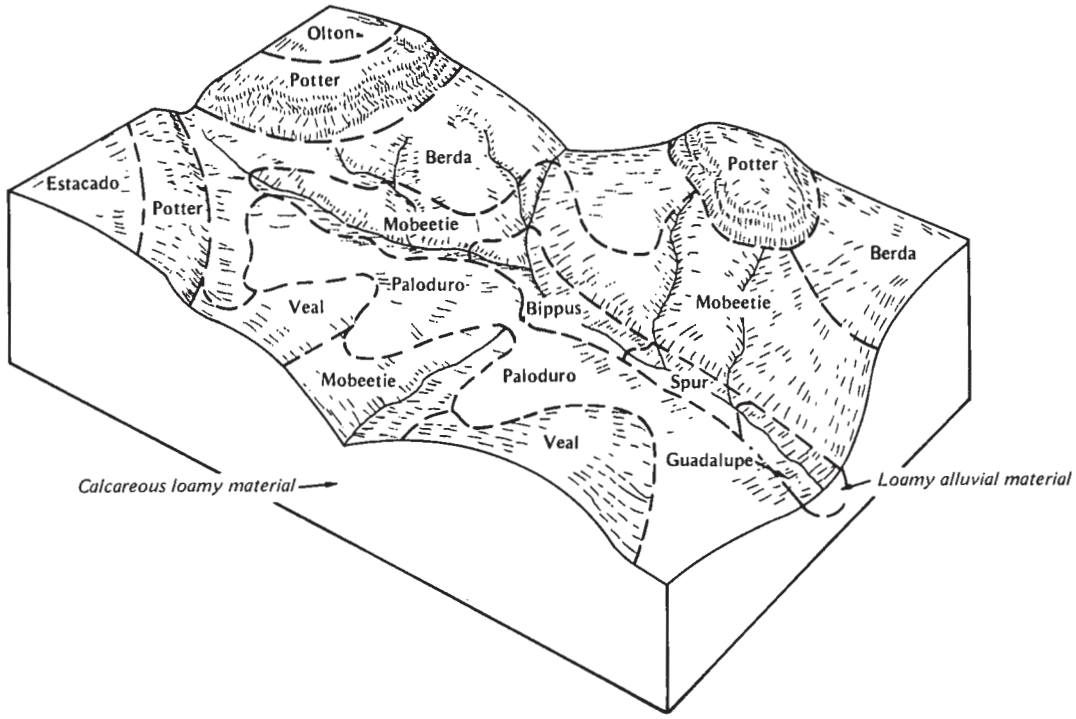



*Figure 1.—Typical pattern of soils in the Mobeetie-Potter-Berda General Soil Map Unit.*

The Paloduro soils are on mid and lower slopes. Typically, the surface layer is dark grayish brown loam about 12 inches thick. The subsoil, to a depth of 36 inches, is brown sandy clay loam; below this, to a depth of 55 inches, it is very pale brown clay loam. The underlying layer, to a depth of 80 inches, is pink sandy clay loam. The soil is calcareous and moderately alkaline throughout.

The other soils in this unit are the moderately permeable Acuff and Veal soils, the moderately slowly permeable Darrouzett and Olton soils, and the very slowly permeable Pullman and Randall soils.

This unit is mostly rangeland. A few areas are cropland. Most cropland areas are irrigated, and the major crops are grain sorghum and wheat.

This map unit is poorly suited to crops because of slope and the erosion hazard. It is well suited to range. This unit is moderately well suited to urban and recreation uses. Slope is the main limitation.

### 3. Likes-Lincoln-Tivoli

*Deep, nearly level to hilly, moderately rapidly to rapidly permeable, sandy soils; on uplands and bottom lands*

Soils in this map unit formed in unconsolidated sandy eolian and alluvial sediment.

This unit covers about 21 percent of the county. Likes soils make up about 39 percent of the unit, Lincoln soils about 23 percent, and Tivoli soils about 15 percent. Other soils make up the rest (fig. 2).

The Likes soils are on hilly areas and undulating to hummocky lower slopes. Typically, the surface layer is brown loamy fine sand about 10 inches thick. The underlying layer, to a depth of 80 inches, is fine sand that is light brown in the upper part and pink in the lower. The soil is moderately alkaline throughout.

The Lincoln soils are on flood plains. Typically, the surface layer, to a depth of 40 inches, is loamy fine sand that is pale brown in the upper part and pink in the lower. Under this, to a depth of 80 inches, is light gray fine sand. The soil is moderately alkaline throughout.

The Tivoli soils are in dune areas. Typically, they are fine sand to a depth of 80 inches. They are brownish and neutral in the upper part and pink and mildly alkaline in the lower part.

The other soils in this unit are the moderately permeable Amarillo, Bippus, Mobeetie, Potter, Tascosa, and Veal soils; the moderately slowly permeable Sweetwater soils; and the moderately rapidly permeable Guadalupe soils.

This unit is mostly range. A few areas are cropland. Low rainfall, low available water capacity, and low fertility are the major limitations for these uses.

This unit is poorly suited to crops. The severe hazard of soil blowing, low fertility, and low available water capacity are the major limitations. The unit is well suited to range.

This unit is moderately well suited to urban uses and poorly suited to recreation uses. The sandy texture is the

main limitation. Some areas are subject to flooding. Also, vertical cutbanks tend to cave off during excavations.

### 4. Pullman-Darrouzett-Olton

*Deep, nearly level to gently sloping, moderately slowly and very slowly permeable, loamy soils; on uplands*

Soils in this map unit formed in ancient eolian sediment.

This unit covers about 8 percent of the county. Pullman soils make up about 53 percent of the unit, Darrouzett soils about 21 percent, and Olton soils 17 percent. Other soils make up the rest (fig. 3).

The Pullman soils are on plains and low ridges. Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 50 inches, is brownish clay. The lower part, to a depth of 80 inches, is clay loam that is yellowish red over reddish yellow. It has many masses of calcium carbonate.

The Darrouzett soil is on convex low upland ridges. Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The upper part of the subsoil, to a depth of 40 inches, is brownish silty clay loam. The lower part, to a depth of 80 inches, is clay loam that grades with depth from brownish to reddish yellow. It has common to many masses of calcium carbonate.

The Olton soils are on low ridges and in shallow swales. Typically, the surface layer is dark brown clay loam about 7 inches thick. The subsoil, to a depth of 80 inches, is clay loam that is brownish in the upper part and reddish yellow over yellowish red in the lower part. There is a distinct accumulation of calcium carbonate (caliche) at a depth of about 48 to 58 inches.

The other soils in this unit are the moderately permeable Acuff, Estacado, Paloduro, and Veal soils. Also included are the very slowly permeable Randall soils in playas.

This unit is used as both irrigated and nonirrigated cropland and rangeland. The major crops are grain sorghum and wheat.

This unit is moderately well suited to crops and range. Droughtiness and moderately slow and very slow permeability are the main limitations. This unit is moderately well suited to urban and recreation uses. The shrinking and swelling, the moderately slow and very slow permeability, and the clayey subsoil are limitations.

### 5. Amarillo-Acuff-Veal

*Deep, nearly level to gently sloping, moderately permeable, loamy soils; on uplands*

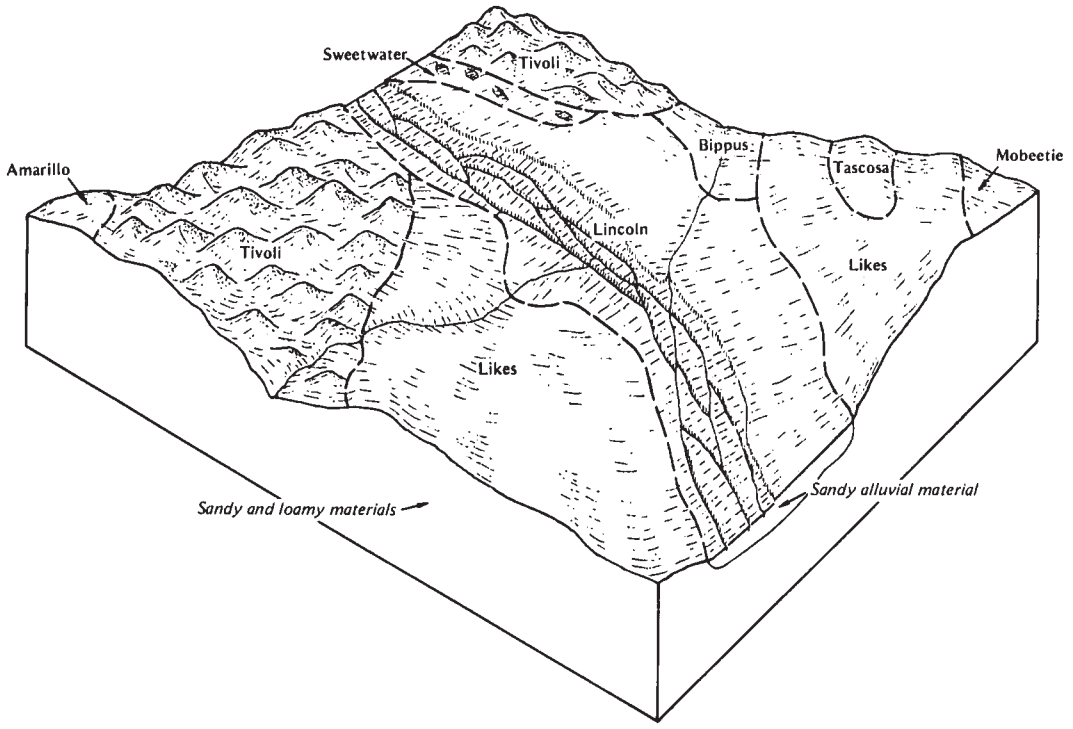



*Figure2.—Typical pattern of soils in the Likes-Lincoln-Tivoli General Soil Map Unit.*

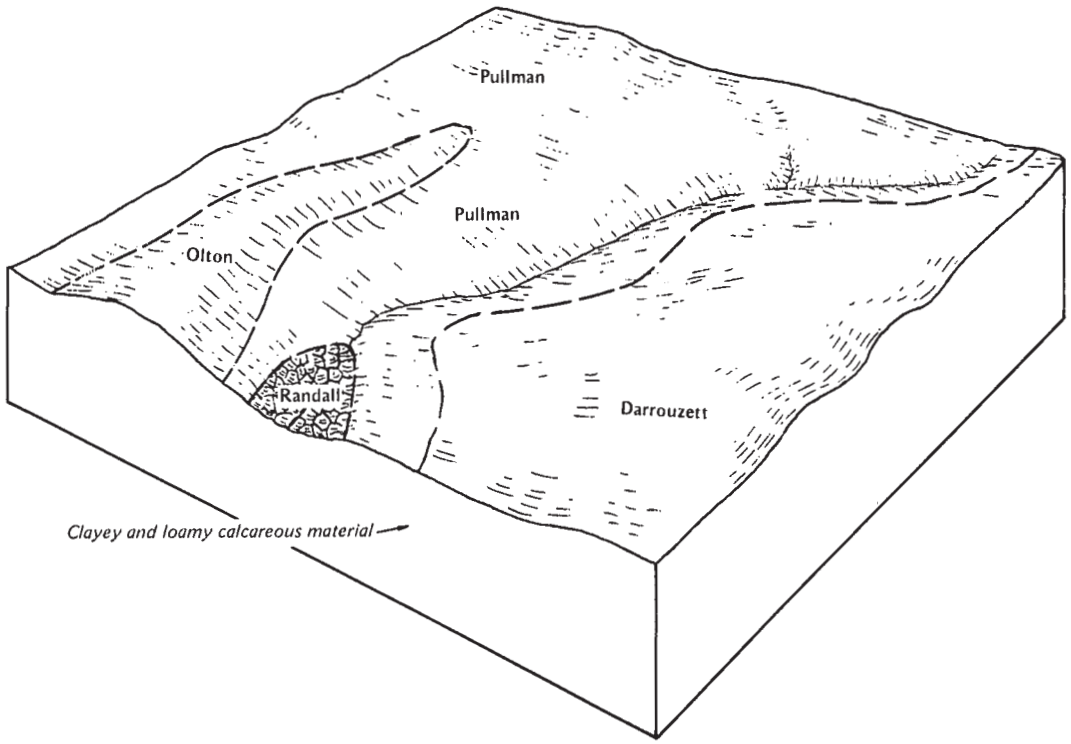



*Figure 3.—Typical pattern of soils in the Pullman-Darrouzett-Olton General Soil Map Unit.*

Soils of this map unit formed in calcareous loamy sediment and outwash, modified by wind.

This unit covers about 6 percent of the county. Amarillo soils make up about 36 percent of the unit, Acuff soils about 26 percent, and Veal soils about 21 percent. Other soils make up the rest (fig. 4).

The Amarillo soils are on upland plains. Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil, to a depth of 65 inches, is reddish brown sandy clay loam. The underlying layer, to a depth of 80 inches, is reddish yellow sandy clay loam. The soil is mildly alkaline to a depth of 30 inches and moderately alkaline below that.

The Acuff soils are on upland plains. Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil, to a depth of 30 inches, is reddish brown clay loam; below this, to a depth of 42 inches, it is reddish yellow sandy clay loam; and below this, to a depth of 80 inches, it is pink clay loam with many masses of calcium carbonate. The soil is neutral in the upper part and moderately alkaline below.

The Veal soils are on convex knolls and ridges. Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil, to a depth of 18 inches, is brown clay loam; below this, to a depth of 35 inches, it is white clay loam; and below this, to a depth of 64 inches, it is pink clay loam. It has many masses of calcium carbonate. The underlying layer, to a depth of 80 inches, is light yellowish brown clay loam. The soil is calcareous and moderately alkaline throughout.

The other soils in this unit are the moderately permeable Estacado, Paloduro, Potter, Tascosa, and Texroy soils; the moderately slowly permeable Olton soils; the rapidly permeable Likes and Lincoln soils; and the moderately rapidly permeable Guadalupe and Mobeetie soils.

This map unit is used as both irrigated and nonirrigated cropland and rangeland. The major crops are grain sorghum and wheat.

This unit is moderately well suited to crops. Soil blowing and slope, in some places, are the main limitations. This unit is well suited to range and urban recreation uses.

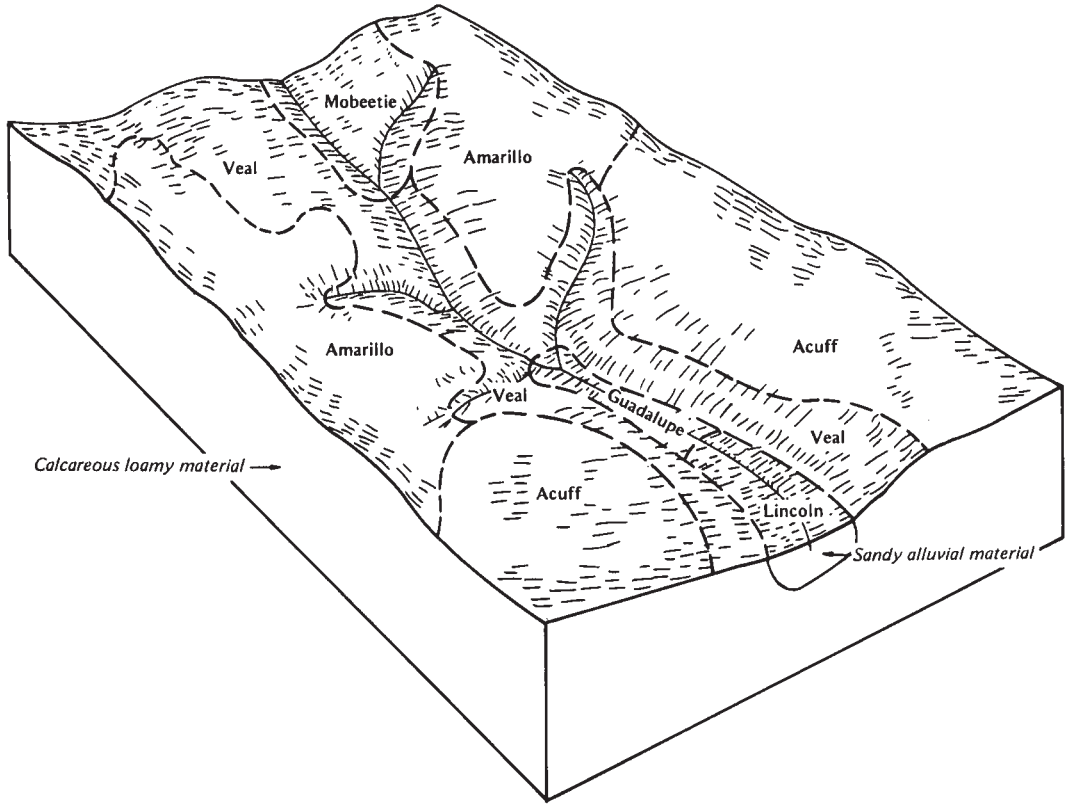



*Figure 4.—Typical pattern of soils in the Amarillo-Acuff-Veal General Soil Map Unit.*

# detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bippus clay loam, 1 to 3 percent slopes, is one of several phases in the Bippus series.

Some map units are made up of two or more major soils. These map units are called soil associations.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Berda-Potter association, steep, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

## soil descriptions

**1—Acuff loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on uplands. Soil areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is dark brown loam about 7 inches thick. The upper part of the subsoil, to a depth of 30 inches, is reddish brown loam; below this, to a depth of 42 inches, it is reddish yellow sandy clay loam. The lower part of the subsoil, to a depth of 80 inches, is pink clay loam and sandy clay loam that is about half calcium carbonate (caliche layer) in the lowest part. Reaction is neutral in the surface layer and moderately alkaline below that.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are both slight.

Included in mapping are small areas of Amarillo, Olton, Texroy, and Veal soils, and areas of nearly level Acuff soils. Also included are small areas of a soil similar to the Acuff soil except that it doesn't have the caliche in the lower subsoil. These inclusions make up less than 25 percent of any mapped area.

This Acuff soil is used mainly for crops and range. Grain sorghum and wheat are the main crops.

This soil is well suited to nonirrigated and irrigated wheat and grain sorghum. Crop residues should be kept on the surface to help control water erosion and soil blowing and conserve moisture. Contour farming and terraces are needed to reduce runoff. Grassed waterways make good outlets for terrace systems. In dry years, when crop residues do not furnish adequate protection, emergency tillage is needed to control soil blowing. A well designed irrigation system and proper application of water are essential if this soil is irrigated. Sprinkler systems are the most suitable. If a surface system is used, bench leveling is necessary. Fertilizer is needed when this soil is irrigated.

This soil is moderately well suited to wildlife habitat. Lack of cover and a limited water supply are the limiting

factors. Bobwhite quail, blue quail, dove, and antelope can be found on this soil.

This soil is well suited to most urban and recreation uses.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation is about 95 percent grasses and 5 percent forbs, by weight.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent, and sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first, and blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. When heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated and irrigated, and the Clay Loam range site.

**2—Acuff loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on uplands. Soil areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown loam about 7 inches thick. The upper part of the subsoil, to a depth of 18 inches, is dark brown clay loam. Below this, to a depth of 80 inches, is sandy clay loam that grades with depth from reddish brown to reddish yellow. The reddish yellow part is about 20 percent calcium carbonate. The soil is neutral in the upper part and moderately alkaline below.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is medium. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in mapping are small areas of Amarillo, Estacado, Olton, and Veal soils and small areas of Acuff loam, 1 to 3 percent slopes. Also included are small areas of a soil that is similar to the Acuff soil, but which has no accumulation of calcium carbonate in the lower subsoil. There's also a few areas where the surface layer has been removed by erosion. These inclusions make up less than 25 percent of any mapped area.

This Acuff soil is used for crops and range. Wheat and grain sorghum are the main crops.

This soil is poorly suited to crops unless the danger of soil erosion is removed. Good management includes leaving crop residues on the surface to help control water erosion and soil blowing and to help conserve moisture. They also help to maintain soil productivity by maintaining the organic matter level. In dry years, when crop residues do not furnish adequate protection, emergency tillage is needed to control soil blowing. Contour farming, terraces, and grassed waterways are needed to control erosion. A well designed irrigation system and proper application of water are essential if this soil is irrigated. Sprinkler systems are the most suitable. If a surface system is used, bench leveling is necessary. Irrigated crops generally need fertilizers.

This soil is well suited to most urban uses. It is corrosive to uncoated steel, but this limitation can be easily overcome by good design and careful construction. This soil is well suited to recreation uses, although the slope restricts some playground uses.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation is about 95 percent grasses and 5 percent forbs, by weight.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent, and sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first, and blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. When heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Clay Loam range site.

**3—Amarillo fine sandy loam, 0 to 1 percent slopes.** This deep, nearly level soil is on uplands. Slopes are plane to slightly concave. Soil areas are oval in shape and range from 5 to 80 acres in size. In most cultivated fields the surface layer has been thinned a few inches by soil blowing.

Typically, the surface layer is reddish brown fine sandy loam about 5 inches thick. The subsoil, to a depth of 72 inches, is reddish brown sandy clay loam. Below this, to a depth of 80 inches, is reddish yellow sandy clay loam. Typically, the soil is neutral in the surface layer and moderately alkaline below.

This soil is well drained, and has a slow surface runoff. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is moderate.

Included in mapping are small areas of Acuff and Veal soils. Also included are small areas of a soil that is similar to the Amarillo soil but which is yellowish in the surface layer, small areas of a closely similar soil that has a subsoil of fine sandy loam, and small areas of gently sloping Amarillo soils. These inclusions make up less than 20 percent of any mapped area.

This Amarillo soil is used for crops and range. Wheat and grain sorghum are the main crops.

This soil is well suited to nonirrigated and irrigated crops. Low rainfall and susceptibility to soil blowing are the most limiting factors. Crop residues should be kept on the surface to help control soil blowing and to conserve moisture. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversions. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is recommended for irrigated crops and dryland crops also, if moisture is adequate. A well designed irrigation system and proper application of irrigation water are necessary if this soil is irrigated. Sprinkler, drip, and surface irrigation systems are suitable. If a surface system is used, however, land leveling may be needed.

This soil is well suited to most urban uses. Seepage is the main limiting factor, but it can be easily overcome by good design and careful construction. This soil is well suited to recreation uses.

In rangeland, the climax plant community is about 50 percent tall and mid grasses. Short grasses make up about 40 percent. Forbs make up 5 percent, and woody plants 5 percent.

Sideoats grama, blue grama, and buffalograss make up as much as 45 percent of all vegetation. Little bluestem, indiangrass, sand bluestem, Canada wildrye, and western wheatgrass make up 25 percent. Switchgrass, Texas bluegrass, silver bluestem, hairy grama, sand dropseed, and Wright threeawn make up 20 percent. Forbs include bush morningglory, western indigo, catclaw sensitivebrier, wild alfalfa, dalea, plains zinnia, bundleflowers, prairie-clover, bushsunflower, and gaura. Woody vegetation includes sagebrush, yucca, skunkbush sumac, catclaw, and black dalea.

If the range is overgrazed, blue grama and buffalograss tend to become the dominant grasses. Grasses such as sand dropseed and threeawn come in after extended abuse. Sand sagebrush will become the dominant brush plant on overgrazed areas. Mesquite is an invader in some areas.

This soil provides habitat primarily for bobwhite and blue quail. Limited cover and lack of winter browse tends to keep deer populations low except in areas of this soil near river bottoms or near rough country. Skunkbush sumac, yucca, forbs, and grasses provide the birds with most of their food requirements. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Sandy Loam range site.

**4—Amarillo fine sandy loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on gently undulating uplands. Soil areas are irregular in shape and range from 5 to 300 acres in size. In most fields the surface layer has been thinned a few inches by soil blowing and water erosion.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil, to a depth of 65 inches, is reddish brown sandy clay loam. Below this, to a depth of 80 inches, is reddish yellow sandy clay loam. The soil is mildly alkaline in the upper part and moderately alkaline below.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are moderate.

Included in mapping are small areas of Acuff and Veal soils. Also included are a few small areas of two soils closely similar to the Amarillo soil. One has a yellowish surface layer; the other has a fine sandy loam subsoil below a depth of about 50 inches. Also included are small areas of nearly level Amarillo soils. These inclusions make up as much as 20 percent of any mapped area.

This Amarillo soil is used for crops and range. Grain sorghum and wheat are the main crops.

This soil is well suited to nonirrigated and irrigated grain sorghum and wheat. Low rainfall, slope, and susceptibility to soil blowing and water erosion are the most limiting factors. Crop residues should be kept on the surface to help control water erosion and soil blowing and to conserve moisture. Contour farming and terraces may be needed to help control water erosion. Diversion terraces may be needed to control runoff water from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is recommended for all irrigated crops. A well designed irrigation system and proper application of water are necessary. Sprinkler, drip, and surface irrigation systems are suitable. If a surface system is used, bench leveling is necessary.

This soil is well suited to most urban and recreation uses.

In rangeland, the climax plant community is about 50 percent tall and mid grasses. Short grasses make up about 40 percent. Forbs make up 5 percent, and woody plants 5 percent.

Sideoats grama, blue grama, and buffalograss make up as much as 45 percent of all vegetation. Little bluestem, indiangrass, sand bluestem, Canada wildrye, and western wheatgrass make up 25 percent. Switchgrass, Texas bluegrass, silver bluestem, hairy grama, sand dropseed, and Wright threeawn make up 20 percent. Forbs include bush morningglory, western indigo, catclaw sensitivebrier, wild alfalfa, dalea, plains

zinnia, bundleflowers, prairie-clover, bushsunflower, and gaura. Woody vegetation includes sand sage, yucca, skunkbush sumac, catclaw, and black dalea.

If the range is overgrazed, blue grama and buffalograss tend to become the dominant grasses. Grasses such as sand dropseed and threeawn come in after extended abuse. Sand sage will become the dominant brush plant on overgrazed areas. Mesquite is an invader in some areas.

This soil provides habitat primarily for bobwhite and blue quail. Limited cover and lack of winter browse tends to keep deer populations very low except in areas of this soil near river bottoms or extremely rough country. Skunkbush sumac, yucca, forbs, and grasses provide the birds with most of their food requirements.

This soil is in capability subclass IIIe, nonirrigated, and IIIe, irrigated. It is in the Sandy Loam range site.

**5—Amarillo fine sandy loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on gently undulating uplands. Soil areas are irregular in shape and range from 5 to 100 acres in size. Soil blowing and water erosion has thinned the original surface layer a few inches in most cultivated fields. A few rills and shallow gullies occur in most fields. The original surface layer has been eroded away in some fields.

Typically, the surface layer is brown fine sandy loam about 8 inches thick. The subsoil, to a depth of 49 inches, is brown sandy clay loam; below this, to a depth of 74 inches, it is light reddish brown sandy clay loam; and below this, to a depth of 80 inches, it is reddish yellow sandy clay loam. The soil is neutral to a depth of 8 inches, mildly alkaline from a depth of 8 inches, and moderately alkaline below.

This soil is well drained, and has medium surface runoff. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are moderate.

Included in mapping are small areas of Acuff, Mobeetie, and Veal soils; small areas of a soil similar to the Amarillo soil but which is yellowish in the surface layer, and another soil that is less clayey in the lower part of the subsoil. Also included are small areas of sloping Amarillo fine sandy loam and some patches of Amarillo loamy fine sand. These inclusions make up less than 20 percent of any mapped area.

This Amarillo soil is used for crops and range. Grain sorghum and wheat are the main crops.

This soil is poorly suited to crops mainly because of the water erosion hazard. It is also subject to soil blowing. Where this soil is farmed, crop residues should be kept on the surface to help control water erosion and soil blowing and to conserve moisture. Contour farming and terraces are needed to control water erosion. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer may be needed for nonirrigated crops and is essential for irrigated crops. A well designed irrigation system and proper application of water are necessary. Sprinkler and drip irrigation systems are suitable.

This soil is well suited to most urban uses. Any limiting factors can be overcome by good design and careful construction. It is well suited to recreation uses.

In rangeland, the climax plant community is about 50 percent tall and mid grasses. Short grasses make up about 40 percent. Forbs make up 5 percent, and woody plants 5 percent.

Sideoats grama, blue grama, and buffalograss make up as much as 45 percent of all vegetation. Little bluestem, indiangrass, sand bluestem, Canada wildrye, and western wheatgrass make up 25 percent. Switchgrass, Texas bluegrass, silver bluestem, hairy grama, sand dropseed, and Wright threeawn make up 20 percent. Forbs include bush morningglory, western indigo, catclaw sensitivebrier, wild alfalfa, dalea, plains zinnia, bundleflowers, prairie-clover, bushsunflower, and gaura. Woody vegetation includes sand sage, yucca, skunkbush sumac, catclaw, and black dalea.

If the range is overgrazed, blue grama and buffalograss tend to become the dominant grasses. Grasses such as sand dropseed and threeawn come in after extended abuse. Sand sagebrush will eventually become the dominant brush plant on overgrazed areas. Mesquite is an invader in some areas.

This soil provides habitat primarily for bobwhite and blue quail. Limited cover and lack of winter browse tend to keep deer populations low except in areas near river bottoms or extremely rough country. Skunkbush sumac, yucca, forbs, and grasses provide the birds with most of their food requirements.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Sandy Loam range site.

**6—Berda-Potter association, steep.** This association is along escarpments and the lower slopes of hills and ridges. The areas are deeply cut by erosional gullies, draws, and creeks (fig. 5). Geological natural erosion is active. Slopes range from 20 to 45 percent. The areas are 10 to about 250 acres in size.

Berda soils make up about 35 percent of the association, Potter soils about 25 percent, and other soils about 40 percent. The areas of this unit are large, and the composition is variable. The detail of mapping, however, is adequate for the foreseeable uses of the soils.

The Berda soils are on hillsides and below escarpments. Typically, the surface layer is brown loam about 10 inches thick. The subsoil, to a depth of 24 inches, is pale brown sandy clay loam. Below this, to a depth of 42 inches, is pink sandy clay loam with about 5 percent calcium carbonate. The underlying layer, to a depth of 60 inches, is pink sandy clay loam. The soil is moderately alkaline throughout.

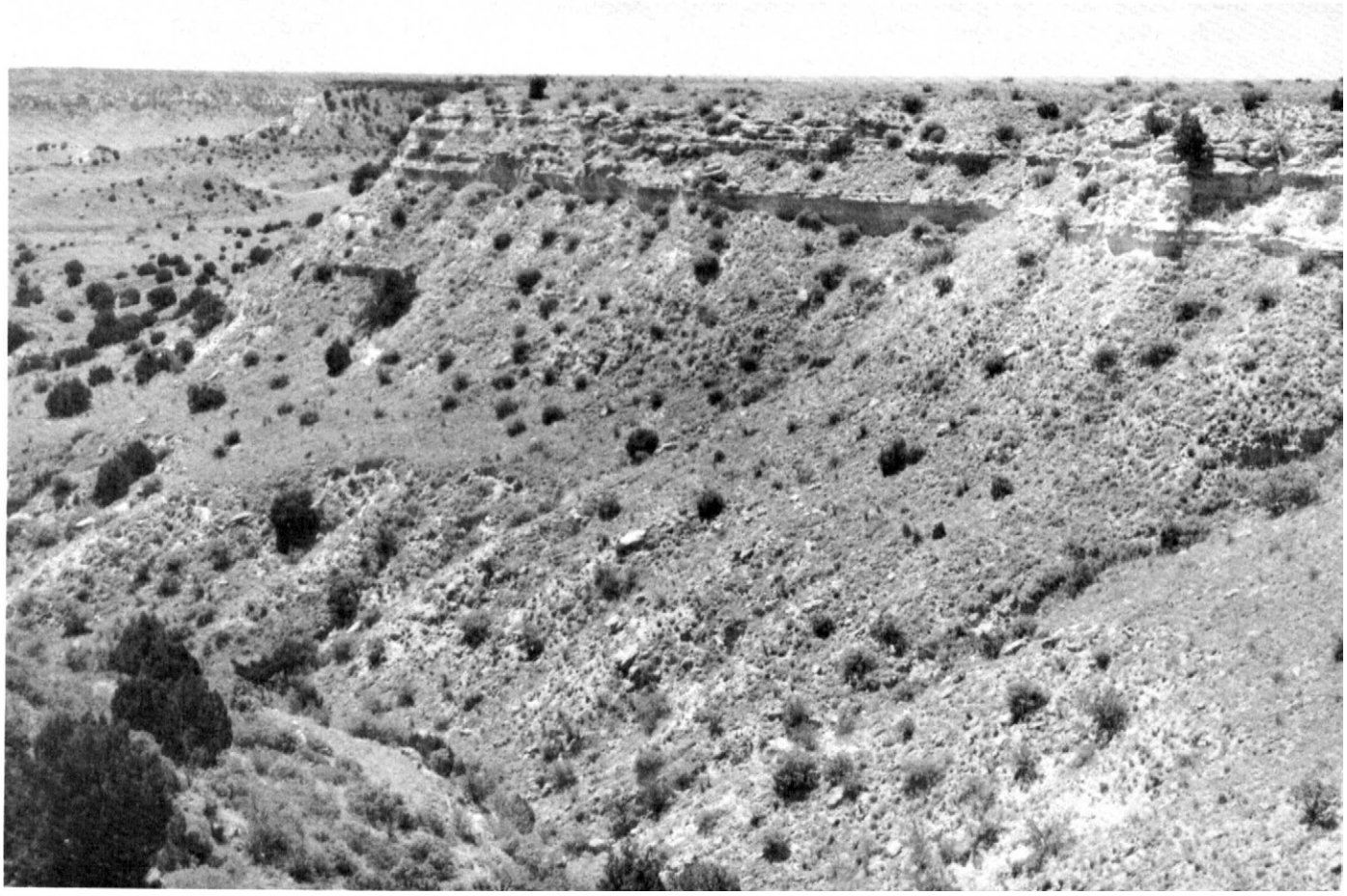


*Figure 5.—Geological (natural) erosion is active in areas of the Berda-Potter association, steep.*

Berda soils are well drained. Surface runoff is rapid. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is severe and the soil blowing hazard is moderate.

The Potter soils occupy strongly convex areas along escarpments and on ridge crests. Typically, the surface layer is brown gravelly loam about 5 inches thick; below this, to a depth of 8 inches, is brown very gravelly loam. The underlying layer is pinkish, fractured, caliche rock with soft calcium carbonate in the cracks. The soil is moderately alkaline throughout.

Potter soils are well drained and surface runoff is rapid. Permeability is moderate, and available water capacity is very low. The root zone is very shallow, and plants have difficulty penetrating the caliche rock. The water erosion hazard is severe.

Other soils in this association are small areas of Acuff, Bippus, Guadalupe, Likes, Lincoln, Amarillo, Mobeeties, Spur, and Veal soils. Some of these soils are gently sloping to moderately steep. Caliche rock outcrops make up the escarpments.

This association is used for rangeland. It is unsuited to cropland.

The soils in this association are poorly suited to most urban and recreation uses. Slope, gravel, and shallow depth to bedrock are the most restrictive features.

In rangeland, the climax plant community on the Berda soils is mostly mid grasses, with lesser amounts of tall and short grasses. The amount of woody plants and forbs is significant. The vegetation by weight is about 75 percent grass, 20 percent woody plants, and 5 percent forbs.

Little bluestem and sideoats grama make up about 40 percent of the total vegetation. Other grasses are sand bluestem, indiangrass, switchgrass, Canada wildrye, New Mexico feathergrass, hairy grama, threeawns, sand

dropseeds, rough tridens, vine-mesquite, blue grama, and silver bluestem. Forbs include dotted gayfeather, catclaw sensitivebrier, black sampson, stemless actinea, and rockdaisy. Woody vegetation includes catclaw acacia, skunkbush sumac, feather and black dalea, redberry juniper, mountainmahogany, hackberry, yucca, and shin oak.

If the range is overgrazed, little bluestem, sand bluestem, and other tall grasses are replaced by sideoats grama, hairy grama, threeawns, and sand dropseed. With continued overgrazing, invader plants will eventually take over. These include broom snakeweed, cactus, hairy tridens, mesquite, and juniper.

The climax plant community on the Potter soils is dominated by tall and mid grasses. Forbs make up as much as 5 percent of the vegetation. Woody plants make up as much as 10 percent.

Sideoats grama makes up about 30 percent of the total vegetation. Little bluestem and blue grama make up about 20 percent. The rest of the grasses are primarily sand bluestem, indiangrass, switchgrass, rough tridens, hairy grama, Wright threeawn, needleandthread, sand dropseed, and silver bluestem. Forbs include bigtop dalea, dotted gayfeather, black sampson, plains actinea, catclaw sensitivebrier, and trailing ratany. Woody vegetation includes catclaw acacia, black dalea, feather dalea, skunkbush sumac, mountainmahogany, and small soapweed.

If the range is overgrazed, catclaw acacia, feather dalea, and skunkbush increase somewhat in density. Sand bluestem, indiangrass, and switchgrass may completely disappear, with their places being taken by shorter grasses such as hairy grama, blue grama, and the threeawns. Eventually, hairy tridens, redberry juniper, mesquite, and annual forbs and grasses will take over.

This association provides ideal habitat for bobwhite and blue quail and mule and white-tailed deer. The topography and shrubs provide good cover for wildlife. Most of the shrubs also are a source of food. Deer frequently use areas of this association for resting and refuge.

The Berda soils are in capability subclass VIe, and the Rough Breaks range site. The Potter soils are in capability subclass VIIs and the Very Shallow range site.

**7—Bippus fine sandy loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on valley fills and outwash fans above the flood plain. It occasionally receives runoff from adjoining higher soils, but not enough to flood out crops. Soil areas are elongated and range from 25 to 250 acres in size.

Typically, the surface layer is brown fine sandy loam about 23 inches thick. The subsoil, to a depth of 80 inches, is brown clay loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are slight.

Included in mapping are small areas of closely similar Guadalupe, Mobeetie, Paloduro, Texroy, and Spur soils and Bippus clay loam. A few eroded, U-shaped gullies that extend headward up drainageways are included, along with a few areas of the sandier Lincoln soils. These inclusions make up as much as 20 percent of some mapped areas.

This Bippus soil is used mostly for range. Many areas are too small or narrow to be practical to cultivate. Where this soil is cultivated, alfalfa, grain sorghum, and wheat are the main crops.

This soil is moderately well suited to nonirrigated and irrigated crops. Keeping crop residues on the surface will conserve moisture and reduce water erosion and soil blowing. Field windbreaks and stripcropping will help control soil blowing. Diversion terraces and grassed waterways will help to control excess runoff from adjacent slopes. Contour farming and terraces are needed to reduce runoff. Irrigated crops need to be fertilized. A well designed irrigation system and proper application of water are essential if this soil is irrigated. Both surface and sprinkler irrigation systems are suitable. If a surface system is used, however, bench leveling is necessary.

For urban and recreation uses, moderate shrinking and swelling with changes in moisture and runoff from surrounding areas are hazards.

The climax plant community is mainly mid and short grasses with a small amount of woody vegetation and forbs. The vegetation by weight is about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

Vine-mesquite, blue grama, sideoats grama, buffalograss, and western wheatgrass make up about 80 percent of the vegetation. About 10 percent is tall dropseed, silver bluestem, and threeawns. Forbs include prairie-clovers, roundhead lespedeza, ground plum, milkvetch, Illinois bundleflower, heath aster, scarlet gaura, western ironweed, Engelmann-daisy, Louisiana sagewort, and pitchersage. Woody vegetation includes cottonwood, hackberry, willows, wild plum, and elm.

If the range is overgrazed, the mid grasses give way to short grasses. Grasses such as vine-mesquite and sideoats grama are replaced by blue grama and buffalograss. With continued abuse these plants will be replaced by threeawns and silver bluestem. Eventually annuals are prevalent. Mesquite is an invader in some areas.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Several of the forbs, woody plants, and grasses provide good cover, browse, and seeds for birds and animals.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Draw range site.

**8—Bippus clay loam, 0 to 1 percent slopes.** This deep, nearly level soil is on colluvial valley fills and

outwash fans. It is rarely flooded from nearby streams. It occasionally receives runoff from higher adjoining soils, but not enough to flood out crops. Soil areas are long and narrow and range from 35 to 350 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 26 inches thick. The subsoil, to a depth of 35 inches, is grayish brown clay loam. Below this, to a depth of 80 inches, it is brown clay loam. The soil is moderately alkaline throughout.

This soil is well drained, and runoff is medium. Permeability is moderate, and available water capacity is high. This soil has good tilth and can be worked over a wide range of moisture conditions. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are slight.

Included in mapping are small areas of closely similar Guadalupe, Paloduro, and Spur soils. Also included are small areas of Bippus fine sandy loam, areas of Lincoln soils, some narrow stream channels and U-shaped gullies, and a few areas that are occasionally flooded. These inclusions make up less than 15 percent of any mapped area.

This Bippus soil is used mostly for range. Many areas are too small or narrow to be practical to cultivate. When this soil is cultivated, wheat, alfalfa, and grain sorghum are the main crops.

This soil is well suited to nonirrigated alfalfa, irrigated alfalfa, wheat, and grain sorghum. Crop residues, stripcropping, and field windbreaks can help to protect the soil from blowing. Residues left on the surface also help to conserve moisture. Contour farming and terraces are needed to control runoff. Diversion terraces may be needed to control excess water from adjacent slopes. Grassed waterways provide good outlets for terrace systems. Fertilizers are recommended for irrigated crops. A well designed irrigation system and proper application of water are essential if this soil is irrigated. Both sprinkler and surface irrigation systems are suitable.

For urban and recreation uses, moderate shrinking and swelling with changes in moisture, runoff from surrounding areas, and rare flooding are hazards.

In rangeland, the climax plant community is mid and short grasses with a small amount of woody vegetation and forbs. The vegetation is by weight about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

Vine-mesquite, blue grama, sideoats grama, buffalograss, and western wheatgrass make up about 70 percent of the vegetation. About 20 percent is made up of tall dropseed, silver bluestem, and threeawns. Forbs include prairie-clover, roundhead lespedeza, ground plum, milkvetch, Illinois bundleflower, heath aster, scarlet gaura, western ironweed, Engelmann-daisy, Louisiana sagewort, and pitchersage. Woody vegetation includes cottonwood, hackberry, willows, wild plum, and elm.

If the range is overgrazed, the mid grasses give way to short grasses. Grasses such as vine-mesquite and sideoats grama are replaced by blue grama and buffalograss. With continued abuse these plants will be replaced by threeawns and silver bluestem. Eventually annuals are prevalent. Mesquite is an invader in some areas.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Several of the forbs, woody plants, and grasses which grow on the soil provide good cover, browse, and seeds for birds and animals.

This soil is in capability subclass IIw, non-irrigated, and IIw, irrigated. It is in the Draw range site.

**9—Bippus clay loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on valley fills and outwash fans above the flood plain. It occasionally receives runoff from adjoining higher soils, but not enough to flood crops. Soil areas are elongated and range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil, to a depth of 27 inches, is dark grayish brown clay loam; below this, to a depth of 45 inches, is brown sandy clay loam; and below this, to a depth of 60 inches, is brown clay loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing hazards are slight.

Included in mapping are small areas of closely similar Guadalupe, Mobeetie, Paloduro, Texroy, and Spur soils. Also included are a few small areas of Bippus fine sandy loam, nearly level Bippus soils, a few eroded U-shaped gullies, and patches of the sandier Lincoln soils. These inclusions make up less than 20 percent of any mapped area.

This soil is used mainly for range. Many areas are too small or narrow to be practical to cultivate. When this soil is cultivated, wheat, grain sorghum, and alfalfa are the main crops.

This soil is well suited to nonirrigated and irrigated alfalfa, grain sorghum, and wheat. Keeping crop residues on the surface will conserve moisture and reduce water erosion and soil blowing. Stripcropping and field windbreaks can also reduce soil blowing. Diversion terraces and grassed waterways will help to control excess runoff from adjacent slopes. Contour farming and terraces are needed to reduce runoff. Irrigated crops need to be fertilized. A well designed irrigation system and proper application of water are essential. Both surface and sprinkler irrigation systems can be used. If a surface system is used, however, bench leveling is necessary.

For urban and recreation uses, moderate shrinking and swelling with changes in moisture and runoff from surrounding areas are hazards.

In rangeland, the climax plant community is mainly mid and short grasses with a small amount of woody vegetation and forbs. The vegetation by weight is approximately 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

Vine-mesquite, blue grama, sideoats grama, buffalograss, and western wheatgrass make up about 70 percent of the vegetation. About 20 percent is made up of tall dropseed, silver bluestem, and threeawns. Forbs include prairie-clover, roundhead lespedeza, ground plum, milkvetch, Illinois bundleflower, heath aster, scarlet gaura, western ironweed, Engelmann-daisy, Louisiana sagewort, and pitchersage. Woody vegetation includes cottonwood, hackberry, willows, wild plum, and elm.

If the range is overgrazed, the mid grasses give way to short grasses. Grasses such as vine-mesquite and sideoats grama are replaced by blue grama and buffalograss. With continued abuse these plants in turn will be replaced by threeawns and silver bluestem. Eventually, annuals will be prevalent. Mesquite is an invader in some areas.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Several of the forbs, woody plants, and grasses on this soil provide good cover, browse, and seeds for birds and animals.

This soil is in capability subclass IIe, non-irrigated, and IIe, irrigated. It is in the Draw range site.

**10—Darrouzett silty clay loam, 0 to 1 percent slopes.** This deep, nearly level soil is on uplands. Slopes are slightly convex and average about 0.5 percent. Soil areas are irregular in shape and range from 20 to 300 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil, to a depth of 40 inches, is silty clay loam that is dark grayish brown in the upper part and dark brown below. Below this, to a depth of 80 inches, it is clay loam. It is reddish brown in the upper part and reddish yellow in the lower. The soil is typically neutral in the upper part and grades with depth to moderately alkaline.

This soil is well drained, and surface runoff is slow. Permeability is moderately slow, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion and soil blowing hazards are slight.

Included in mapping are small areas of Acuff, Estacado, Olton, Pullman, and Randall soils and small areas of soils similar to Darrouzett. One of the similar soils has a clay loam surface layer; another has no layer high in carbonates in the lower subsoil. Small areas of gently sloping Darrouzett soils are also included. These inclusions make up as much as 20 percent of some mapped areas.

This soil is used for crops and range. Grain sorghum and wheat are the main crops.

This soil is well suited to nonirrigated and irrigated grain sorghum and wheat. Low rainfall and soil blowing are the most limiting factors. Crop residues should be kept on the soil surface to help control soil blowing and to conserve moisture. Contour farming will reduce erosion on long slopes. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Both sprinkler and surface irrigation systems are suitable. If a surface system is used, land leveling may be necessary.

This soil is moderately well suited to most urban uses. Moderate shrinking and swelling with changes in moisture and corrosiviity to uncoated steel are the main limiting factors. These can be overcome by proper design and careful construction. This soil is moderately well suited to recreation uses. Moderately slow permeability is the most limiting factor.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation is approximately 95 percent grasses and 5 percent forbs by weight.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent, and sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first, and blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIe irrigated. It is in the Clay Loam range site.

**11—Devol loamy fine sand, 3 to 8 percent slopes.** This deep, nearly level to gently sloping soil is on uplands. Slopes are undulating and average about 5 percent. Soil areas are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is brown loamy fine sand about 12 inches thick. The subsoil, to a depth of 24 inches, is brown fine sandy loam. Below this, to a depth of 50 inches, it is loamy fine sand that is reddish in the upper part and brownish in the lower. Below this, to a depth of 80 inches, the lower part of the subsoil is brown fine sandy loam that grades with depth to sandy clay loam. The soil is neutral in the upper part and moderately alkaline in the lower.

This soil is well drained, and surface runoff is slow. Permeability is moderately rapid, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is severe.

Included in mapping are small areas of Amarillo, Likes, Tascosa, Tipton, Mobeetie, and Tivoli soils. These inclusions make up less than 25 percent of any mapped area.

This Devol soil is used for range.

This soil is poorly suited to crops because of the severe soil erosion hazard. A continuous cover of crop residues and field windbreaks can help control erosion. The best suited crops are grain sorghum, forage sorghum, and rye.

This soil is well suited to most urban uses. Seepage and soil blowing are the most limiting factors. It is moderately well suited to recreation uses. The sandy surface layer and the slope are the most limiting factors.

In rangeland, the climax plant community is a prairie of mainly tall grasses. Cool-season grasses are an important part of the vegetation. By weight, the vegetation is approximately 80 percent grass, 10 percent forbs, and 10 percent woody plants.

Little bluestem, sand bluestem, indiangrass, and sideoats grama make up as much as 60 percent of the total vegetation. About 20 percent is switchgrass, Canada wildrye, Texas bluegrass, needleandthread, sand lovegrass, blue grama, hairy grama, Wright threeawn, sand dropseed, silver bluestem, and sand paspalum. Forbs include lead plant, wild alfalfa, bigtop dalea, roundhead lespedeza, mentzelia, catclaw sensitivebrier, yellow neptunia, Illinois bundleflower, gaura, prairie-clover, queensdelight, Fendler penstemon, prairie spiderwort, and erect dayflower. Woody vegetation includes sand sagebrush, shinnery oak, sandplum, skunkbush sumac, and yucca.

If the range is overgrazed, tall grasses are replaced by short grasses. Woody plants such as sand sagebrush and yucca increase. Annual grasses such as sandbur and low lovegrass invade the site along with a variety of annual forbs. In advanced stages of range deterioration short grasses are dominant and tall grasses are found only in protected areas in clumps of brush.

This soil provides habitat for quail, turkey, deer, and prairie chicken. The tall grasses provide excellent escape cover and nesting cover for ground-nesting birds. The wide variety of forbs and brushy woody plants offers excellent food source for most common wildlife. The general wildlife habitat is better on this soil than on all others except those in Bottomland range sites.

This soil is in capability subclass IVe and the Loamy Sand range site.

**12—Estacado clay loam, 0 to 1 percent slopes.** This deep, nearly level soil is on upland plains. Slopes average about 0.6 percent. Soil areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is brown clay loam about 13 inches thick. The subsoil, to a depth of 80 inches, is brown clay loam. The content of calcium carbonate decreases with depth from about 30 percent to about 5 percent. The soil is moderately alkaline throughout.

This soil is well drained and surface runoff is slow. Permeability is moderate, and available water capacity is high. This soil has good tilth. The root zone is easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is moderate.

Included in mapping are small areas of Acuff, Darrouzett, Pullman, Spur, and Olton soils. Also included are a few small areas of a soil similar to Estacado soil except that it has a lighter colored surface layer. These inclusions make up less than 15 percent of any mapped area.

This Estacado soil is used for crops and range. Wheat and grain sorghum are the main crops.

This soil is well suited to nonirrigated and irrigated crops, but careful management is needed to keep crop residues on the soil surface through critical erosion periods. Stripcropping and field windbreaks can also reduce soil blowing. Residues also help to conserve moisture and maintain soil fertility. Occasionally, emergency tillage to roughen the surface is necessary to reduce wind damage when crop growth does not produce enough residues for protective cover. This soil needs to be fertilized when it is irrigated. Surface or sprinkler irrigation systems can be used. A well designed system and proper application of water are essential if this soil is irrigated.

This soil is moderately well suited to most urban uses. Corrosivity to uncoated steel is the most limiting factor, but this can be easily overcome by good design and careful construction. This soil is well suited to recreation uses.

In rangeland, the climax plant community is dominated by mid grasses. Forbs and woody plants may make up as much as 10 percent of the vegetation.

Sideoats grama, the dominant species, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up another 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants will decrease and the vegetation will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope because of the abundance of quality forbs.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Loamy range site.

**13—Estacado clay loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on uplands. Slopes average about 2 percent. Soil areas are irregular to elongated in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 15 inches thick. The subsoil, to a depth of 28 inches, is light brown clay loam that is about 20 percent calcium carbonate; below this, to a depth of 65 inches, is reddish yellow clay loam that is about 25 percent calcium carbonate; and below this, to a depth of 86 inches, the subsoil is light brown clay loam that is about 5 percent calcium carbonate. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is slow. Permeability is moderate, and available water capacity is high. The root zone is deep, and easily penetrated by plant roots. The water erosion and soil blowing hazards are moderate.

Included in mapping are small areas of Acuff, Olton, Paloduro, Pullman, and Veal soils and small areas of nearly level Estacado soils. A few small areas with rills and small gullies in cultivated fields are also included. These inclusions make up less than 20 percent of any mapped area.

This Estacado soil is used for crops and range. Wheat and grain sorghum are the main crops.

This soil is moderately well suited to nonirrigated and irrigated crops. Crop residues left on the surface will help protect the soil from water erosion and soil blowing. Residues also help to conserve moisture. Field windbreaks and stripcropping will help control soil blowing. In dry years, emergency tillage is needed to control soil blowing where crop residues do not provide adequate protection. Contour farming and terraces are needed on this soil. Grassed waterways make good outlets for diversions and terrace systems when excess water is a problem. When cuts or excavations exceed a depth of 20 inches, there is a hazard of cutting into soil material that contains concentrations of calcium carbonate. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Sprinkler or surface irrigation systems can be used. Bench leveling is needed, however, if a surface system is used.

This soil is well suited to most urban uses. Corrosivity to uncoated steel and low strength affecting roads and streets are the main limitations. This soil is well suited to recreation uses.

In rangeland, the climax plant community is dominated by mid grasses. Occasional forbs and woody plants may make up as much as 10 percent of the vegetation.

Sideoats grama, which is dominant, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up another 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants in turn will decrease and the vegetation will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope because of the abundance of quality forbs.

This soil is in capability subclass IIIe, nonirrigated, and IIIe, irrigated. It is in the Loamy range site.

**14—Estacado clay loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on uplands. Slopes average about 4 percent. Soil areas are irregular to elongated in shape and range from 5 to 40 acres in size.

Typically, the soil has a surface layer of dark grayish brown loam about 11 inches thick. The subsoil, to a depth of about 80 inches, is clay loam that is brownish in the upper part and reddish yellow in the lower. From 30 to 45 inches in depth the subsoil is about half carbonate. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion and soil blowing hazards are moderate.

Included in mapping are small areas of Acuff, Bippus, Olton, Paloduro, Spur, and Veal soils. Also included are small areas of gently sloping Estacado soils and a few eroded areas where most of the surface layer has been removed and there are some rills. These inclusions make up less than 25 percent of any mapped area.

This Estacado soil is used for crops and range.

This soil is poorly suited to nonirrigated and irrigated wheat and grain sorghum. Where it is cultivated, intensive management practices are needed. Crop residues need to be left on the surface to help protect the soil from water erosion and soil blowing. Residues also help to conserve moisture. In dry years, emergency tillage is needed to control soil blowing where crop residues do not provide adequate protection. Stripcropping and field windbreaks also help control soil blowing. Contour farming and terraces are needed on this soil. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems when excess water is a problem. When cuts or excavations exceed a depth of 20 inches, there is a hazard of cutting into soil material that contains concentrations of calcium carbonate. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Sprinkler irrigation systems are most suitable. Some bench leveling is needed if a surface system is used.

This soil is moderately well suited to native range plants. Low rainfall limits production of mid and short grasses such as sideoats grama, blue grama, and buffalograss. If overgrazed, the range will deteriorate to short grasses, threeawns, ragweed, broom snakeweed, pricklypear, and yucca.

This soil is moderately well suited to most urban uses. Corrosivity to uncoated steel is the main limiting feature. It is moderately well suited for recreation uses. Slope restricts some playground uses.

In rangeland, the climax plant community is dominated by mid grasses. Occasional forbs and woody plants may make up as much as 10 percent of the vegetation.

Sideoats grama, which is dominant, makes up as much as 35 percent of the vegetation. Blue grama and buffalograss make up another 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants will in turn decrease and the vegetation will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope because of the abundance of quality forbs.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Loamy range site.

**15—Estacado-Paloduro association, rolling.** This association is on sloping to moderately steep uplands. The landforms are hills and ridges with a few narrow gullies and drainageways. Geologic (natural) erosion is active. Slopes range from 5 to 16 percent and average about 10 percent. Local relief varies from 30 to 100 feet. Soil areas range from 10 to about 500 acres in size.

Estacado soils make up about 60 percent of the association, Paloduro soils about 35 percent, and other soils about 5 percent. Mapping these soils separately was not practical because their use and management are similar.

The Estacado soils occupy ridges and the convex upper side slopes of hills and ridges.

Typically, the surface layer is dark grayish brown clay loam about 11 inches thick. The subsoil, to a depth of 80 inches, is clay loam that is brown in the upper part and reddish yellow in the lower. It is 5 to 10 percent calcium carbonate. The soil is moderately alkaline throughout.

The Estacado soils are well drained, and runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is severe, and the soil blowing hazard is moderate.

The Paloduro soils occupy the lower slopes of hills and ridges. Typically, the surface layer is dark grayish brown loam about 15 inches thick. The subsoil, to a depth of 80 inches, is brown clay loam. The soil is moderately alkaline throughout.

Paloduro soils are well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is severe, and the soil blowing hazard is slight.

Other soils in this association are Berda, Bippus, Potter, and Spur soils in small areas. Also included are some nearly barren gullied areas in drainageways created by geological (natural) erosion.

The soils in this association are not suited to cultivation and are used mainly as range.

This association is moderately well suited to most urban and recreation uses. Slope and corrosivity to uncoated steel are the most restrictive features. These features can be overcome with good design and careful construction.

In rangeland, the climax plant community on the Estacado soils is dominated by mid grasses. Scattered forbs and woody plants make up as much as 10 percent of the vegetation.

Sideoats grama, the dominant plant, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up another 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants in turn give way to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

In rangeland, the climax plant community on the Paloduro soils is dominated by mid and short grasses. Forbs make up as much as 5 percent of the vegetation. Scattered woody plants also make up about 5 percent.

Blue grama makes up as much as 35 percent of the total vegetation. Sideoats grama and buffalograss together make up about 25 percent. The remaining grasses are little bluestem, silver bluestem, Wright threeawn, sand dropseed, vine-mesquite, fall witchgrass, plains bristlegrass, and hairy grama. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and penstemon. Woody vegetation includes yucca and catclaw.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues these plants too will be grazed out. The range eventually will deteriorate to pricklypear, broom snakeweed, ragweed, prairie coneflower, sand dropseed, and threeawns. Mesquite is an invader in some areas.

This association provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope because of the abundance of quality forbs.

The Estacado soils are in capability subclass VIe and the Loamy range site. The Paloduro soils are in capability subclass VIe and the Hardland Slopes range site.

**16—Guadalupe fine sandy loam, occasionally flooded.** This deep, nearly level soil is on bottom lands. Slopes average about 0.5 percent. Soil areas are mostly up to 1,000 feet wide and lie along creeks and streams. This soil floods for a few hours about once every 1 to 15 years.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil, to a depth of 50 inches, is brownish stratified fine sandy loam and loam. The underlying layer, to a depth of 80 inches, is stratified, pale brown clay loam and very pale brown fine sandy loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is slow. Permeability is moderately rapid, and available water capacity is low. The root zone is deep and easily penetrated by plant roots. The soil blowing hazard is moderate.

Included in mapping are small areas of Bippus, Likes, Lincoln, Mobeetie, Paloduro, Spur, Sweetwater, and Tivoli soils. Also included are some narrow stream channels and a few areas where the water table is within 40 inches of the surface for a few months of the year. These inclusions make up less than 20 percent of any mapped area.

This Guadalupe soil is used for crops and range.

This soil is well suited to nonirrigated and irrigated alfalfa, grain sorghum, and wheat. Occasional flooding and susceptibility to soil blowing are the most limiting factors. Crop residues need to be kept on the surface to help control soil blowing and to conserve moisture. Stripcropping and field windbreaks can also help prevent soil blowing. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversion terraces. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Sprinkler irrigation systems are most suitable. If a surface system is used, land leveling is usually necessary.

Flooding and seepage are the main limiting factors for urban and recreation uses.

In rangeland, the climax plant community is dominated by tall and mid grasses. There is also a significant amount of desirable forbs and woody plants. The vegetation by weight is approximately 75 percent grass, 10 percent forbs, and 15 percent woody plants.

Switchgrass, sand bluestem, and indiangrass may make up as much as 50 percent of the total vegetation. The other grasses are little bluestem, Canada wildrye, sideoats grama, needleandthread, Texas bluegrass, vine-mesquite, tall dropseed, sand dropseed, blue grama, inland saltgrass, silver bluestem, western wheatgrass, and plains bristlegrass. Forbs include roundhead lespedeza, prairie-clover, scarlet gaura, western ironweed, western ragweed, sagewort, Maximilian sunflower, pitchersage, trailing wildbean, bushsunflower, Illinois bundleflower, yellow neptunia, dalea, false gaura, heath aster, and Englemann-daisy. Woody vegetation includes cottonwood which may be up to 10 percent of the total vegetation. Other woody plants are willow, hackberry, sand sagebrush, sand grape, sand plum, skunkbush sumac, and American licorice.

If the range is overgrazed, tall grasses are rapidly grazed out and replaced by blue grama, buffalograss, and sand dropseed. Eventually, cottonwood, willows, and salt cedar may increase and form a dense canopy.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Many of the woody plants, forbs, and grasses provide good cover, browse, and seeds for birds and animals. Deer use areas of this soil for escape cover.

This soil is in capability subclass IIw, nonirrigated, and IIw, irrigated. It is in the Sandy Bottomland range site.

**17—Likes loamy fine sand, 1 to 8 percent slopes.** This deep, gently sloping to sloping soil is on uplands. Slopes are undulating and average about 4 percent. Soil areas are irregular in shape and range from 5 to 375 acres in size.

Typically, the surface layer is brown loamy fine sand about 10 inches thick. The underlying layer, to a depth of 80 inches, is fine sand that is light brown in the upper part and pink in the lower. The soil is moderately alkaline throughout.

This soil is excessively drained, and surface runoff is slow. Permeability is moderately rapid, and available water capacity is low. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is severe.

Included in mapping are small areas of Amarillo, Devol, Guadalupe, Lincoln, Mobeetie, Potter, Tascosa, Tivoli, and Veal soils. Also included are a few small areas of reddish shale and sandstone outcrops. These inclusions make up less than 15 percent of any mapped area.

This Likes soil is used mostly as rangeland. It is not suited to cultivation.

This soil is moderately well suited to most urban uses. Sandy texture, seepage, slope, and caving off of banks during excavations are the limiting factors. This soil is poorly suited to recreation uses. The sandy texture is a detriment to foot and vehicular traffic.

In rangeland, the climax plant community is a prairie of mainly tall grasses. Cool-season grasses are an important part of the vegetation. By weight, the vegetation is approximately 80 percent grass, 10 percent forbs, and 10 percent woody plants.

Little bluestem, sand bluestem, indiangrass, and sideoats grama make up as much as 60 percent of the total vegetation. About 20 percent is switchgrass, Canada wildrye, Texas bluegrass, needleandthread, sand lovegrass, blue grama, hairy grama, Wright threeawn, sand dropseed, silver bluestem, and sand paspalum. Forbs include lead plant, wild alfalfa, bigtop dalea,

roundhead lespedeza, mentzelia, catclaw sensitivebrier, yellow neptunia, Illinois bundleflower, gaura, prairie-clover, queensdelight, Fendler penstemon, prairie spiderwort, and erect dayflower. Woody vegetation includes sand sagebrush, shinnery oak, sandplum, skunkbush sumac, and yucca.

If the range is overgrazed tall grasses are replaced by short grasses. Woody plants such as sand sagebrush (fig. 6) and yucca increase. Annual grasses such as sandbur and low lovegrass invade the site along with a variety of annual forbs. In advanced stages of range deterioration short grasses are dominant and tall grasses are found only in protected areas in clumps of brush.

This soil provides habitat for quail, turkey, deer, and prairie chicken. The tall grasses provide excellent escape cover and nesting cover for ground-nesting birds. The wide variety of forbs and brushy woody plants offers excellent food sources for most common forms of wildlife. The general wildlife habitat is better on this soil than on all other soils except those on the bottom lands.

This soil is in capability subclass VIe, non-irrigated, and the Loamy Sand range site.

**18—Likes-Tascosa association, hilly.** This association is on moderately steep to steep uplands. These areas are dominated by gravelly hills, knolls, and ridges with narrow valleys and drainageways. Slopes range from about 10 to 30 percent and average about 20 percent. Local relief varies from 20 to 100 feet. The areas range from 10 to about 1,000 acres in size.

Likes soils make up about 50 percent of this association, Tascosa soils about 30 percent, and other soils about 20 percent. These soils could have been mapped separately, but the detail given in this survey is adequate for most foreseeable uses of the soils.

The Likes soils occupy the mid and lower slopes of knolls and ridges. Typically, the surface layer is brown loamy fine sand about 10 inches thick. The underlying layer, to a depth of 80 inches, is brown loamy fine sand. The soil is moderately alkaline throughout.

Likes soils are excessively drained. Surface runoff is slow. Permeability is moderately rapid, and available water capacity is low. The root zone is deep. The water erosion hazard is moderate, and the soil blowing hazard is severe.

*Figure 6.—Invasion of sand sagebrush as a result of overgrazing on Likes loamy fine sand, 1 to 8 percent slopes.*

The Tascosa soils occupy the crests and upper slopes of the hills, knolls, and ridges. Typically, the surface layer is brown gravelly fine sandy loam about 7 inches thick. The subsoil, to a depth of 14 inches, is brown very gravelly sandy loam. The underlying layer, to a depth of 50 inches, is pink gravelly sandy loam. The soil is moderately alkaline throughout.

Tascosa soils are well drained. Surface runoff is rapid. Permeability is moderate. The available water capacity is low because of the gravel. The root zone is deep, but the gravelly layers affect plant root growth. The water erosion hazard is severe.

Other soils in this association are Acuff, Amarillo, Berda, Devol, Guadalupe, Lincoln, Mobeetie, Paloduro, Potter, Spur, Tivoli, and Veal soils in small areas and outcrops of reddish sandstone and shale. Also included are a few small areas that are mined for gravel.

The soils in this association are not suited to cultivation. They are used mainly as rangeland. Some of the thicker beds of gravel are mined for construction material.

This association is poorly suited to most urban and recreation uses. Slope, small stones, and seepage are the most restrictive features.

In rangeland, the climax plant community on the Likes soils is a prairie of mainly tall grasses. Cool-season grasses are an important part of the vegetation. The vegetation by weight is approximately 80 percent grass, 10 percent forbs, and 10 percent woody plants.

Little bluestem, sand bluestem, indiangrass, and sideoats grama make up as much as 60 percent of the total vegetation. About 20 percent is switchgrass, Canada wildrye, Texas bluegrass, needleandthread, sand lovegrass, blue grama, hairy grama, Wright threeawn, sand dropseed, silver bluestem, and sand paspalum. Forbs include lead plant, wild alfalfa, bigtop dalea, roundhead lespedeza, mentzelia, catclaw sensitivebrier, yellow neptunia, Illinois bundleflower, gaura, prairie-clover, queensdelight, Fendler penstemon, prairie spiderwort, and erect dayflower. Woody vegetation includes sand sagebrush, shinnery oak, sandplum, skunkbush sumac, and yucca.

If the range is overgrazed tall grasses are replaced by short grasses. Woody plants such as sand sagebrush and yucca increase. Annual grasses such as sandbur and low lovegrass invade the site along with a variety of annual forbs. In advanced stages of range deterioration short grasses are dominant and tall grasses are found only in protected areas in clumps of brush.

In rangeland, the climax plant community on the Tascosa soils is a grass community dominated by tall and mid grasses. Forbs and shrubs are common. The vegetation by weight is approximately 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

Sideoats grama makes up about 30 percent of the vegetation. Indiangrass, little bluestem, sand bluestem, and hairy grama make up as much as 45 percent. The rest of the grass vegetation is mostly black grama, Wright threeawn, blue grama, sand dropseed, and buffalograss. Forbs include plains actinea, dotted gayfeather, black sampson, bush morninglory, bigtop dalea, and catclaw sensitivebrier. Woody vegetation includes catclaw acacia, feather dalea, skunkbush sumac, yucca, and juniper.

If the range is overgrazed, sand bluestem, little bluestem, and indiangrass thin out and are replaced by shorter grasses such as hairy grama, blue grama, and threeawn. Invaders are hairy tridens and annual grasses and forbs.

This soil association provides habitat for quail, turkey, deer, and prairie chicken. The tall grasses provide excellent escape cover and nesting cover for ground-nesting birds. The wide variety of forbs and brushy woody plants offers excellent food sources for most common forms of wildlife. The general wildlife habitat is better on this map unit than all other soils except those on bottom lands.

The Likes soils are in capability subclass VIe and the Loamy Sand range site. The Tascosa soils are in capability subclass VIs and the Gravelly range site.

**19—Lincoln fine sand, frequently flooded.** This deep, nearly level soil is on bottom lands. Surfaces are slightly wavy, and slopes average about .5 percent. Soil areas are elongated in shape and range from 5 to 1,000 acres in size. Frequency of flooding ranges from as often as 5 times a year to about once every 3 years. Most areas have a water table at a depth of 5 to 8 feet.

Typically, the surface layer is pale brown fine sand about 12 inches thick. The underlying layer, to a depth of 40 inches, is pink loamy fine sand. Below this, to a depth of 80 inches, is light gray fine sand. The soil is moderately alkaline throughout.

This soil is somewhat excessively drained, and surface runoff is slow. Permeability is rapid, and available water capacity is low. The root zone is deep and easily penetrated by plant roots. Flood waters scour some areas while others are left with a thin layer of fresh alluvium. The soil blowing hazard is severe.

Included in mapping are small areas of Guadalupe, Likes, Spur, Sweetwater, and Tivoli soils. Also included are sandy and gravelly stream channels, a soil like the Lincoln soil that has grayish mottles at a depth of about 40 inches, and another that has a water table above a depth of 5 feet. These inclusions make up less than 20 percent of any mapped area.

This Lincoln soil is used mostly as rangeland. It is not suitable for cropland.

Frequent flooding is the main limiting factor for urban and recreational uses.

In rangeland, the climax plant community is a prairie dominated by tall and mid grasses. There is also a significant amount of desirable forbs and woody plants. The vegetation by weight is approximately 75 percent grass, 10 percent forbs, and 15 percent woody plants.

Switchgrass, sand bluestem, and indiangrass may make up as much as 50 percent of the total vegetation. The other grasses are little bluestem, Canada wildrye, sideoats grama, needleandthread, Texas bluegrass, vine-mesquite, tall dropseed, sand dropseed, blue grama, inland saltgrass, silver bluestem, western wheatgrass, giant sandreed, and plains bristlegrass. Forbs include roundhead lespedeza, prairie-clover, scarlet gaura, western ironweed, western ragweed, sagewort, Maximilian sunflower, pitcher sage, trailing wildbean, bushsunflower, Illinois bundleflower, yellow neptunia, dalea, false gaura, heath aster, and Engelmann-daisy. Woody vegetation includes cottonwood, which may be up to 10 percent of the total vegetation. Other woody plants are willow, hackberry, sand sagebrush, sand grape, sand plum, skunkbush sumac, and American licorice.

If the range is overgrazed, tall grasses are rapidly reduced and are replaced by blue grama, buffalograss, and sand dropseed. Cottonwood, willows, and saltcedar may increase and form a dense canopy.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Many of the woody plants, forbs, and grasses provide good cover, browse, and seeds for game birds and animals. Deer use areas of this soil for escape cover.

This soil is in capability subclass Vw, nonirrigated, and the Sandy Bottomland range site.

**20—Mobeetie fine sandy loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on the lower slopes of hills and ridges. Soil areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil, to a depth of 30 inches, is pale brown fine sandy loam; below this, to a depth of 48 inches, it is light yellowish brown fine sandy loam. The underlying layer, to a depth of 80 inches, is light brown fine sandy loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderately rapid, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is moderate.

Included in mapping are small areas of Amarillo, Berda, Bippus, Guadalupe, Likes, Lincoln, Paloduro, Spur, and Veal soils. Also included are a few small areas of Mobeetie soils with slope of 3 to 5 percent, some narrow stream channels, and a soil similar to the Mobeetie soil but that is noncalcareous in the upper part. These inclusions make up as much as 20 percent of any mapped area.

This Mobeetie soil is used primarily as rangeland. The few areas that are cropped are in grain sorghum and wheat.

This soil is moderately well suited to nonirrigated and irrigated crops. High calcium carbonate content and susceptibility to soil blowing are the most limiting factors. The soil is also subject to washing. Crop residues need to be kept on the surface to help control water erosion and soil blowing and to conserve moisture. This can best be done by close-spaced planting of these crops. Field windbreaks and stripcropping also help prevent soil blowing. Contour farming and terraces may be needed to help control water erosion. Diversion terraces may be needed to control water from adjoining slopes. Fertilizer is needed when this soil is cropped. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Both sprinkler and drip irrigation systems are suitable.

This soil is well suited to urban and recreation uses. Seepage is the main limiting factor. The slope restricts some playground uses.

In rangeland, the climax plant community is a prairie that is about 60 percent tall and mid grasses, 30 percent short grasses, 5 percent forbs, and 5 percent woody vegetation.

Most of the grasses are sideoats grama, little bluestem, sand bluestem, and blue grama. The rest of the grasses are mostly indiangrass, Canada wildrye, western wheatgrass, buffalograss, silver bluestem, hairy grama, Wright threeawn, sand dropseed, black grama, and needleandthread. Forbs include catclaw sensitivebrier, dotted gayfeather, prairie clover, Engelmann-daisy, bushsunflower, dalea, heath aster, pitchersage, western ragweed, bundleflower, and gaura. Woody vegetation includes yucca, sand sagebrush, shinnery oak, skunkbush sumac, and ephedra.

If the range is overgrazed, blue grama and buffalograss increase quickly to replace the tall and mid grasses that are being grazed out. Continued abuse brings an increase in sand sagebrush, sand dropseed, hairy tridens, Texas grama, and western ragweed. Mesquite is an invader in some areas.

This soil provides habitat for bobwhite and blue quail. In some areas there is a limited number of deer that frequent the draws where the brush cover is good. Skunkbush sumac, yucca, forbs, and grasses provide most of the wildlife food requirements.

This soil is in capability subclass IVe, nonirrigated and irrigated. It is in the Mixedland Slopes range site.

**21—Mobeetie fine sandy loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on the lower slopes of hills and ridges. Slopes average about 4 percent. Soil areas are elongated in shape and range from 5 to 150 acres in size.

Typically, the surface layer is brown fine sandy loam about 12 inches thick. The subsoil, to a depth of 24 inches, is light yellowish brown fine sandy loam; below this, to a depth of 42 inches, is very pale brown fine sandy loam. The substratum, to a depth of 80 inches, is reddish yellow fine sandy loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderately rapid, and available water

capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion and soil blowing hazards are moderate.

Included in mapping are small areas of Amarillo, Berda, Bippus, Guadalupe, Likes, Lincoln, Paloduro, Devol, Spur, Tascosa, and Veal soils. Also included are a small areas of sloping Mobeetie soils, a soil similar to the Mobeetie soil but that is noncalcareous in the upper part, and a few narrow stream channels. These inclusions make up as much as 20 percent of any mapped area.

This Mobeetie soil is used primarily as rangeland.

This soil is poorly suited to crops. Grain sorghum and wheat are the main crops in the few cultivated areas. The main problems are the erosion caused by the slope, the texture, and the high content of carbonates. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve moisture. Field windbreaks and stripcropping also help prevent soil blowing. Contour farming is needed to help control water erosion. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversions. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is cropped. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Both sprinkler and drip irrigation systems are suitable.

This soil is well suited to most urban and recreation uses. The slope restricts some playground uses.

In rangeland, the climax plant community is a prairie that is about 60 percent tall and mid grasses, 30 percent short grasses, 5 percent forbs, and 5 percent woody vegetation.

Sideoats grama, little bluestem, sand bluestem, and blue grama make up most of the grasses. The rest is mainly indiangrass, Canada wildrye, western wheatgrass, buffalograss, silver bluestem, hairy grama, Wright threeawn, sand dropseed, black grama, and needleandthread. Forbs include catclaw sensitivebrier, dotted gayfeather, prairie clover, Engelmann-daisy, bushsunflower, dalea, heath aster, pitchersage, western ragweed, bundleflower, and gaura. Woody vegetation includes yucca, sand sagebrush, shinnery oak, skunkbush sumac, and ephedra.

If the range is overgrazed, blue grama and buffalograss increase quickly to replace the tall and mid grasses that are being grazed out. Continued abuse brings an increase in sand sagebrush, sand dropseed, hairy tridens, Texas grama, and western ragweed. Mesquite is an invader in some areas.

This soil provides habitat for bobwhite and blue quail. In some areas there is a limited number of deer that frequent the draws where the brush cover is good. Skunkbush sumac, yucca, forbs, and grasses provide most of the wildlife food requirements.

This soil is in capability subclass IVe, nonirrigated and irrigated. It is in the Mixedland Slopes range site.

**22—Mobeetie fine sandy loam, 5 to 12 percent slopes.** This deep, sloping to strongly sloping soil is on uplands, mainly on footslopes. Slopes are slightly concave and average about 8 percent. Soil areas are elongated in shape and range from 5 to 200 acres in size. U-shaped gullies occur in some drainageways as a result of continued geological (natural) erosion of the valleys and headward extension of the drainageways.

Typically, the surface layer is pale brown fine sandy loam about 7 inches thick. The subsoil, to a depth of 28 inches, is pale brown fine sandy loam; below this, to a depth of 51 inches, it is light brown fine sandy loam. The underlying layer, to a depth of 80 inches, is light yellowish brown fine sandy loam. The soil is moderately alkaline throughout.

This soil is well drained, and runoff is medium. Permeability is moderately rapid, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is severe, and the soil blowing hazard is moderate.

Included in mapping are small areas of Amarillo, Berda, Devol, Guadalupe, Likes, Lincoln, Paloduro, Potter, Spur, Tascosa, and Veal soils. Also included are areas of gently sloping and moderately steep Mobeetie soils and some gullied areas. These inclusions make up less than 20 percent of any mapped area.

This Mobeetie soil is used primarily as rangeland. It is not suited to cropland.

This soil is moderately well suited to urban and recreation uses. The slope is the most limiting factor.

In rangeland, the climax plant community is about 60 percent tall and mid grasses, 30 percent short grasses, 5 percent forbs, and 5 percent woody vegetation.

Sideoats grama, little bluestem, sand bluestem, and blue grama make up most of the grasses. The rest is indiangrass, Canada wildrye, western wheatgrass, buffalograss, silver bluestem, hairy grama, Wright threeawn, sand dropseed, black grama, and needleandthread. Forbs include catclaw sensitivebrier, dotted gayfeather, prairie clover, Engelmann-daisy, bushsunflower, dalea, heath aster, pitchersage, western ragweed, bundleflower, and gaura. Woody vegetation includes yucca, sand sagebrush, shinnery oak, skunkbush sumac, and ephedra.

If the range is overgrazed, blue grama and buffalograss increase quickly to replace the tall and mid grasses that are being grazed out. Continued abuse brings an increase in sand sagebrush, sand dropseed, hairy tridens, Texas grama, and western ragweed. Mesquite is an invader in some areas.

This soil provides habitat for bobwhite and blue quail. In some areas there is a limited number of deer that frequent the draws where the brush cover is good. Skunkbush sumac, yucca, forbs, and grasses provide most of the wildlife food requirements.

This soil is in capability subclass VIe, nonirrigated, and the Mixedland Slopes range site.

**23—Mobeetie-Veal-Potter association, rolling.** This association is on sloping to moderately steep uplands dissected by erosional valleys and drainageways. In places, geological (natural) erosion is active. Slopes range from 5 to 16 percent and average about 8 percent. Local relief varies from 30 to 100 feet. The areas range from 10 to about 1,000 acres in size.

Mobeetie soils make up about 45 percent of the association, Veal soils about 20 percent, Potter soils about 20 percent, and other soils about 15 percent. The areas of this unit are large, and the composition is variable. The detail of mapping is adequate, however, for the foreseeable uses of the soils.

The Mobeetie soils occupy the lower slopes of hills and ridges and foot slopes below escarpments. Typically, the surface layer is brown fine sandy loam about 9 inches thick. The subsoil, to a depth of 45 inches, is brown and light yellowish brown fine sandy loam. The underlying layer, to a depth of 80 inches, is light yellowish brown sandy clay loam.

Mobeetie soils are well drained, and surface runoff is medium. Permeability is moderately rapid, and available water capacity is medium. The root zone is deep. The water erosion hazard is severe, and the soil blowing hazard is moderate.

The Veal soils occupy convex crests and upper slopes of hills and ridges. Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil, to a depth of 19 inches, is light yellowish brown fine sandy loam that is about 20 percent visible calcium carbonates. Below this, to a depth of 60 inches, is pink fine sandy loam that is about 40 percent, by volume, visible calcium carbonate. The soil is moderately alkaline throughout.

Veal soils are well drained, and runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep. The water erosion hazard is severe, and the soil blowing hazard is moderate.

The Potter soils occupy strongly sloping to moderately steep convex crests of hills and ridges. Typically, the surface layer is brown loam about 10 inches thick. The substratum, to a depth of 13 inches, is pale brown gravelly loam. Below this, to a depth of 60 inches, is weakly cemented caliche. The soil is moderately alkaline throughout.

Potter soils are well drained, and surface runoff is rapid. Permeability is moderate, and available water capacity is very low. The root zone is very shallow. The water erosion hazard is severe.

Included in mapping are small areas of Acuff, Amarillo, Berda, Bippus, Guadalupe, Likes, Lincoln, Mobeetie, Paloduro, Veal, Spur, and Tascosa soils. Also included are a few caliche rock outcrops and reddish shale outcrops.

The soils in this association are not suited to cultivation. They are used primarily as rangeland.

This soil is moderately well suited to most urban and recreation uses. The slope and shallow depth over caliche rock in the areas of Potter soils are the most restrictive features.

In rangeland, the climax plant community on the Mobeetie soils is about 60 percent tall and mid grasses, 30 percent short grasses, 5 percent forbs, and 5 percent woody vegetation.

Sideoats grama, little bluestem, sand bluestem, and blue grama make up most of the grasses. The rest is indiangrass, Canada wildrye, western wheatgrass, buffalograss, silver bluestem, hairy grama, Wright threeawn, sand dropseed, black grama, and needleandthread. Forbs include catclaw sensitivebrier, dotted gayfeather, prairie clover, Engelmann-daisy, bushsunflower, dalea, heath aster, pitchersage, western ragweed, bundleflower, and gaura. Woody vegetation includes yucca, sand sagebrush, shinnery oak, skunkbush sumac, and ephedra.

If the range is overgrazed, blue grama and buffalograss increase quickly to replace the tall and mid grasses as they are grazed out. Continued abuse brings an increase in sand sagebrush, sand dropseed, hairy tridens, Texas grama, and western ragweed.

In rangeland, the climax plant community on the Veal soils is dominated by mid grasses. Forbs and woody plants may make up as much as 10 percent of the vegetation.

Sideoats grama, the dominant plant, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up another 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants in turn will decrease and the vegetation will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

In rangeland, the climax plant community on the Potter soils is dominated by tall and mid grasses. Forbs make up as much as 5 percent of the vegetation. Woody plants comprise less than 10 percent.

Sideoats grama makes up about 30 percent of the total vegetation. Little bluestem and blue grama make up about 20 percent. The rest of the grasses are primarily sand bluestem, indiangrass, switchgrass, rough tridens, hairy grama, Wright threeawn, needleandthread, sand dropseed, and silver bluestem. Forbs include bigtop dalea, dotted gayfeather, black sampson, plains actinea, catclaw sensitivebrier, and trailing ratany. Woody vegetation includes catclaw acacia, black dalea, feather dalea, skunkbush sumac, mountainmahogany, and small soapweed.

If the range is overgrazed, catclaw acacia, feather dalea, and skunkbush sumac increase somewhat in

density. Sand bluestem, indiangrass, and switchgrass may completely disappear, with their place taken by shorter grasses such as hairy grama, blue grama, and threeawns. Some common invaders to this site are hairy tridens, redberry juniper, mesquite, and annual forbs and grasses.

This association provides habitat for bobwhite and blue quail. In some areas there is a limited number of deer that frequent the draws where the brush cover is good. Skunkbush sumac, yucca, forbs, and grasses provide most of the wildlife food requirements.

The Mobeetie soils are in capability subclass VIe and the Mixedland Slopes range site. The Veal soils are in capability subclass VIe and the Loamy range site. The Potter soils are in capability subclass VIIs and the Very Shallow range site.

**24—Obaro-Quinlan association, rolling.** This association is on ridges and hills of upland interstream divides. Slopes range from 5 to 16 percent. Mapped areas are mostly oblong in shape and range from 10 to 200 acres in size.

Obaro soils make up about 50 percent of this association, Quinlan soils about 40 percent, and other soils about 10 percent. Most of the individual areas of Obaro and Quinlan soils are large enough to be separated at the scale mapped, but the detail given here is adequate for most present and foreseeable uses of the soils.

The Obaro soils occupy concave and convex hillside slopes, benches, and foot slopes below ridges and escarpments. Typically, the surface layer is reddish brown loam about 5 inches thick. The subsoil, to a depth of 13 inches, is yellowish red loam; below this, to a depth of 25 inches, it is reddish yellow silty clay loam. The underlying layer, to a depth of 60 inches, is yellowish red, weakly cemented calcareous siltstone. The soil is moderately alkaline throughout.

The Obaro soils are well drained, and surface runoff is medium to rapid. Permeability is moderate, and available water capacity is low. The root zone is moderately deep and is easily penetrated by plant roots. The water erosion hazard is severe, and the soil blowing hazard is slight.

Quinlan soils occupy the strongly sloping to moderately steep crests and upper slopes of hills and ridges. Typically, the surface layer is light reddish brown loam about 5 inches thick. The subsoil, to a depth of 14 inches, is yellowish red loam. The underlying layer, to a depth of 60 inches, is reddish yellow, weakly cemented sandstone. The soil is moderately alkaline throughout. In some places the surface layer is silt loam or silty clay loam.

The Quinlan soils are well drained, and surface runoff is rapid. Permeability is moderate, and available water capacity is very low. The root zone is shallow. The soil blowing hazard is slight, and the water erosion hazard is severe.

Other soils in this association are mainly Likes, Lincoln, Mobeetie, and Tascosa soils. Also included are some gullies resulting from downcutting by erosion through headward extension of drainageways. Small areas of caliche rock outcrops and outcrops of reddish shale and sandstone also occur in this unit.

This association is moderately well suited to most urban uses. Shallow depth of the Quinlan soil over rock and the slope are the most limiting factors. This association is moderately well suited to recreation uses. Slope and the loamy surface layer, which gets dusty with foot traffic, are the most limiting factors.

The climax plant community is a prairie dominated by mid grasses. The vegetation by weight is 80 percent grass, 15 percent forbs, and 5 percent woody vegetation.

Sideoats grama makes up as much as 35 percent of the total vegetation. Little bluestem and blue grama make up about 20 percent. The remaining grass vegetation is primarily vine-mesquite, sand bluestem, buffalograss, silver bluestem, and sand dropseed. Forbs include groundplum, milkvetch, wild alfalfa, dotted gayfeather, heath aster, bigtop dalea, sagewort, Engelmann-daisy, bushsunflower, prairie-clover, and trailing ratany. Woody vegetation includes feather dalea, black dalea, redberry juniper, and yucca.

If the range is overgrazed, sideoats grama, little bluestem, sand bluestem, and vine-mesquite thin out. Buffalograss, silver bluestem, sand dropseed, threeawns, yucca, and broom snakeweed begin to increase. Forage production is reduced. Further deterioration of the range leads to an invasion of mesquite and numerous annuals.

This association provides habitat for deer, dove, and quail. Many of the forbs provide good forage for deer and seed for game birds.

The soils in this association are in capability subclass VIe and the Loamy Prairie range site.

**25—Olton clay loam, 0 to 1 percent slopes.** This deep, nearly level soil is on uplands. Slopes are slightly convex and average about 0.5 percent. Soil areas are irregular in shape and range from 20 to 350 acres in size.

Typically, the surface layer is dark brown clay loam about 17 inches thick. The subsoil, to a depth of 32 inches, is reddish brown clay loam; below this, to a depth of 48 inches, it is pink clay loam that is about 10 percent masses and films of calcium carbonate. The subsoil below this, to a depth of 80 inches, is reddish yellow clay loam. The soil is neutral in the upper part and moderately alkaline below.

This soil is well drained, and surface runoff is slow. Permeability is moderately slow, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion and soil blowing hazards are slight.

Included in some areas of this soil are small areas of Acuff, Darrouzett, Estacado, Pullman, and Randall soils; areas of a soil similar to the Olton soil but which has a

light-colored surface layer; and small areas of gently sloping Olton soils. These inclusions make up less than 20 percent of any mapped area.

This soil is used as cropland and rangeland. Grain sorghum and wheat are the main crops.

This soil is well suited to nonirrigated and irrigated crops. Soil blowing is a hazard. Crop residues should be kept on the surface to help control soil blowing and to conserve moisture. Diversion terraces may be needed to control runoff water from adjacent slopes. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary. Both sprinkler and surface irrigation systems are suitable. If a surface system is used, however, land leveling may be necessary.

This soil is moderately well suited to most urban uses. Shrinking and swelling with changes in moisture and corrosivity to uncoated steel are the main limiting factors but these can be overcome by proper design and careful construction. This soil is also moderately well suited to recreation uses. Moderately slow permeability is the most limiting factor. Slope restricts some playground uses.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent, and sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, sand dropseed, and tobosa make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama thins out while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

**26—Olton clay loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on uplands. Slopes are slightly convex and average about 1.7 percent. Soil areas are irregular in shape and range from 10 to 200 acres in size. Soil blowing and water erosion have removed a few inches of the surface layer in most cultivated fields.

Typically, the surface layer is dark brown clay loam about 7 inches thick. The subsoil, to a depth of 17 inches, is dark brown clay loam; below that, to a depth of 58 inches, it is reddish brown clay loam that is about 10 percent calcium carbonate in the upper part and 35 percent in the lower part. The lower part of the subsoil, to a depth of 65 inches, is reddish yellow clay loam; below this, to a depth of 80 inches, is yellowish red clay loam. The soil is neutral in the surface layer and moderately alkaline below.

This soil is well drained, and surface runoff is medium. Permeability is moderately slow, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in some areas of this soil are small areas of Acuff, Darrouzett, Estacado, Pullman, and Randall soils. Also included is a soil similar to the Olton soil but which has a darker surface layer. These inclusions make up as much as 20 percent of some mapped areas.

This Olton soil is used as both cropland and rangeland. Grain sorghum and wheat are the main crops.

This soil is moderately well suited to nonirrigated and irrigated grain sorghum and wheat. Slope and susceptibility to water erosion are the most limiting factors. Crop residues should be kept on the surface to help control water erosion and soil blowing and to conserve moisture. Contour farming and terraces are needed to help control water erosion. Diversion terraces may be needed to control runoff water from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary. Sprinkler irrigation systems are suitable. If a surface system is used, bench leveling is necessary.

This soil is moderately well suited to urban and recreation uses. Shrinking and swelling with changes in moisture, low strength affecting roads and streets, and corrosivity to uncoated steel are the main limiting factors for urban uses. These can be overcome by proper design and careful construction. The moderately slow permeability and slope in some places are the most limiting factors for recreation.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama.

If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIIe, irrigated. It is in the Clay Loam range site.

**27—Olton clay loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on uplands. Soil areas are irregular in shape and range from 10 to 100 acres in size. Soil blowing and water erosion have removed a few inches of the surface layer in most cultivated fields.

Typically, this soil has a surface layer of brown clay loam about 15 inches thick. The subsoil, to a depth of 49 inches, is brownish clay loam. Below this, to a depth of 60 inches, the subsoil is reddish yellow clay loam with about 30 percent calcium carbonate in the upper part decreasing to none in the lower part. The soil is neutral in the upper part and moderately alkaline below.

This soil is well drained, and surface runoff is medium. Permeability is moderately slow, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in some areas of this soil are small areas of Acuff, Darrouzett, Estacado, and Pullman soils. Also included are small areas of a soil similar to the Olton soil but which has a light-colored surface layer. These inclusions make up as much as 20 percent of some mapped areas.

This Olton soil is used as both cropland and rangeland. Grain sorghum and wheat are the main crops.

This soil is poorly suited to crops unless the hazard of water erosion is controlled. Crop residues should be kept on the soil surface to help control water erosion and soil blowing and to conserve moisture. Contour farming and terraces are needed to help control water erosion. Diversion terraces may be needed to control runoff water from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Sprinkler irrigation systems are suitable. If a surface system is used, bench leveling is necessary.

This soil is moderately well suited to urban uses. Shrinking and swelling with changes in moisture, low strength affecting roads and streets, and corrosivity to uncoated steel are the main limiting factors. This soil is moderately well suited to recreation uses. The moderately slow permeability and slope are the most limiting factors.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite together make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss. Mesquite is an invader in some areas.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Clay Loam range site.

**28—Paloduro loam, 3 to 5 percent slopes.** This deep, gently sloping soil is on weakly concave footslopes of uplands. Slopes average about 4 percent. Soil areas are irregular in shape and range from 5 to 100 acres in size. Some areas have U-shaped gullies caused by geological (natural) erosion of valleys and headward extension of drainageways.

Typically, the surface layer is dark grayish brown loam about 14 inches thick. The subsoil, to a depth of 28 inches, is grayish brown sandy clay loam; below this, to a depth of 48 inches, is light brown sandy clay loam. The underlying layer, to a depth of 80 inches, is pink sandy clay loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in some areas of this soil are small areas of Berda, Bippus, Estacado, Mobeetie, Potter, and Veal soils. Some sloping Paloduro soils are also included. These inclusions make up as much as 20 percent of some mapped areas.

This Paloduro soil is used mostly as rangeland. The few cropland areas are mainly grain sorghum and wheat.

This soil is poorly suited to crops unless the water erosion hazard is controlled. Where cropped, residues should be kept on the surface to help control water and wind erosion and to conserve moisture. Contour farming and terraces are needed to help control water erosion. Diversion terraces may be needed to control runoff water from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop

residues do not furnish adequate protection. Fertilizer is needed when this soil is in irrigated crops. A well designed irrigation system and proper application of water are necessary. Sprinkler, surface, and drip irrigation systems are suitable. If a surface system is used, bench leveling is necessary.

This soil is well suited to most urban uses. Slope and corrosivity to uncoated steel are the main limiting factors, but these can be overcome by proper design and careful construction. This soil is moderately well suited to recreation uses. Slope, which restricts playground uses, is the most limiting factor.

In rangeland, the climax plant community is a prairie dominated by mid and short grasses. Forbs make up as much as 5 percent of the vegetation. Scattered woody plants make up about 5 percent.

Blue grama makes up as much as 35 percent of the total vegetation. Sideoats grama and buffalograss together make up about 25 percent. The remaining grasses are little bluestem, silver bluestem, Wright threeawn, sand dropseed, vine-mesquite, fall witchgrass, plains bristlegrass, and hairy grama. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and penstemon. Woody vegetation includes yucca and catclaw.

If the range is overgrazed, sideoats grama and little bluestem will give way to blue grama and buffalograss. If heavy grazing continues these plants too will be grazed out. The range eventually will deteriorate to pricklypear, broom snakeweed, ragweed, prairie coneflower, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope, primarily because of the forbs.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Hardland Slopes range site.

**29—Paloduro loam, 5 to 8 percent slopes.** This deep soil occupies sloping uplands. It is on weakly concave footslopes that average about 6 percent slope. Soil areas are irregular in shape and range from 5 to 100 acres in size. Some areas have U-shaped gullies caused by geological (natural) erosion of valleys and headward extension of drainageways.

Typically, the surface layer is dark grayish brown loam about 12 inches thick. The subsoil, to a depth of 36 inches, is brown sandy clay loam. Below this, to a depth of 55 inches, it is very pale brown clay loam. The underlying layer, to a depth of 80 inches, is pink sandy clay loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in mapping are small areas of Berda, Bippus, Estacado, Likes, Mobeetie, Potter, and Veal soils. Also included are a few areas of caliche rock outcrop, small areas of gently sloping Paloduro soils, and areas of a soil similar to the Paloduro soil but which has a caliche layer in the subsoil. These inclusions make up as much as 20 percent of some mapped areas.

This Paloduro soil is used mainly as rangeland and is not suited to crops.

This soil is moderately suited to most urban uses. The slope and corrosivity to uncoated steel are the main limiting factors. For recreation uses, this soil is also moderately well suited. Slope is the most limiting factor.

In rangeland, the climax plant community is a prairie dominated by mid and short grasses (fig. 7). Forbs make up as much as 5 percent of the vegetation. Scattered woody plants also make up about 5 percent.

Blue grama makes up as much as 35 percent of the total vegetation. Sideoats grama and buffalograss together make up about 25 percent. The remaining grasses are little bluestem, silver bluestem, Wright threeawn, sand dropseed, vine-mesquite, fall witchgrass, plains bristlegrass, and hairy grama. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and penstemon. Woody vegetation includes yucca and catclaw.

If the range is overgrazed, sideoats grama and little bluestem will give way to blue grama and buffalograss. If heavy grazing continues these plants too will be grazed out. The site eventually will deteriorate to pricklypear, broom snakeweed, ragweed, prairie coneflower, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope, primarily because of the forbs.

This soil is in capability subclass VIe, nonirrigated, and the Hardland Slopes range site.

**30—Paloduro-Estacado-Potter association, rolling.** This association is on sloping to moderately steep uplands dissected by erosional valleys and drainageways. Geological (natural) erosion is active in some places. Slopes are from 5 to 16 percent and average about 10 percent. Local relief varies from 30 to 100 feet. Soil areas range from 10 to about 500 acres in size.

Paloduro soils make up about 45 percent of this association, Estacado soils about 25 percent, Potter soils about 15 percent, and other soils about 15 percent. Areas of this unit are large and the composition is variable. The mapping is adequate, however, for most present and foreseeable uses of the soils.

The Paloduro soils occupy mid slopes and foot slopes, mostly below escarpments. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The subsoil, to a depth of 30 inches, is pale brown sandy clay loam. Below this, to a depth of 50 inches, it is light yellowish brown sandy clay loam. The underlying layer, to a depth of 80 inches, is light brown sandy clay loam. The soil is moderately alkaline throughout.

Paloduro soils are well drained, and runoff is medium. Permeability is moderate, and available water capacity is

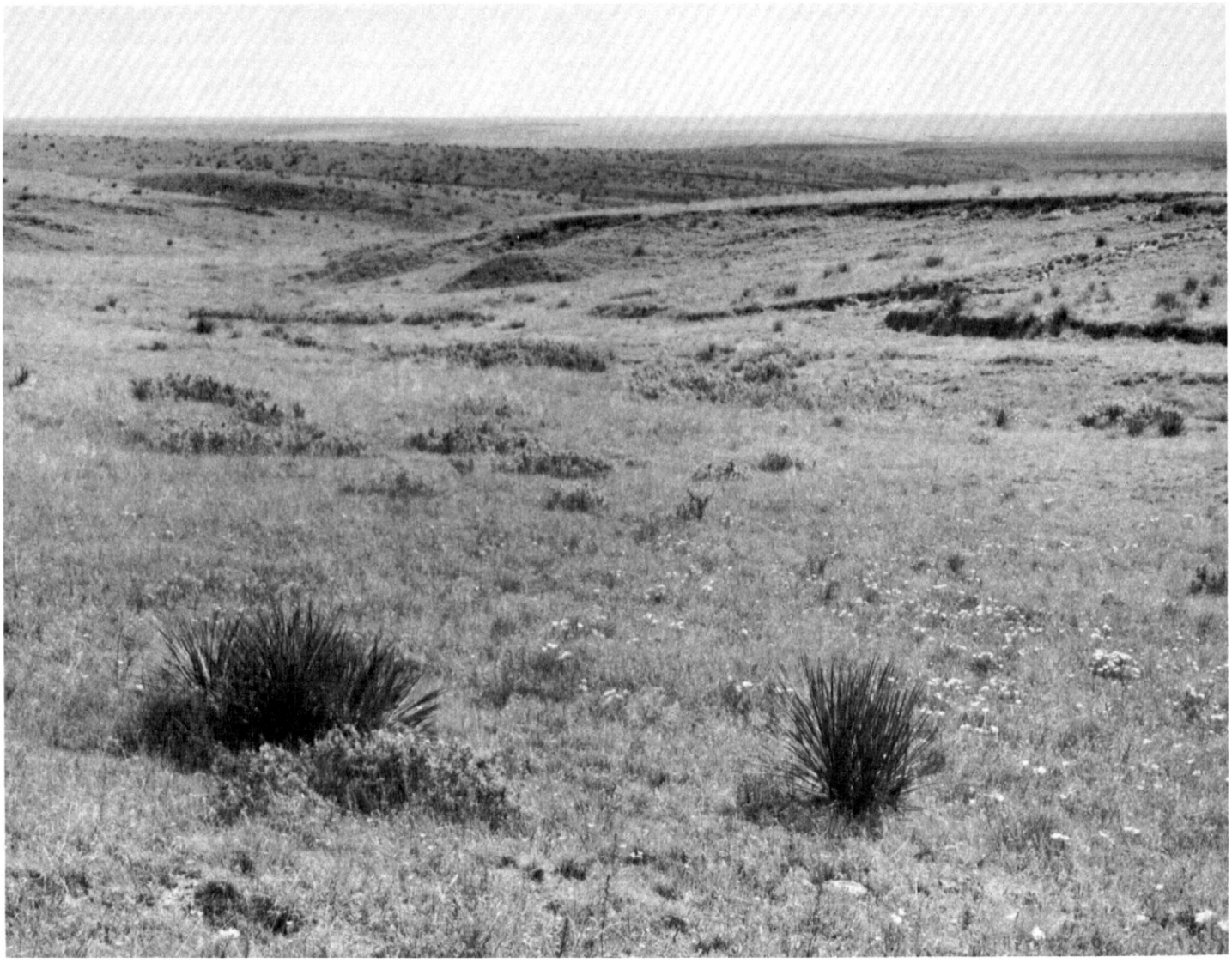


*Figure 7.—Mid and short grasses dominate the climax plant community on Paloduro loam, 5 to 8 percent slopes, in rangeland.*

high. The root zone is deep. The water erosion hazard is severe, and the soil blowing hazard is slight.

The Estacado soils occupy the upper slopes of hills and ridges and the less sloping areas in the association. Typically, the surface layer is brown clay loam about 11 inches thick. The subsoil, to a depth of 24 inches, is brown clay loam. Below this, to a depth of 35 inches, is reddish brown clay loam that is about 20 percent calcium carbonate. The lower part of the subsoil, to a depth of 80 inches, is yellowish red clay loam that is about 10 percent calcium carbonate. The soil is neutral in the surface layer and moderately alkaline below.

The Estacado soils are well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is high. The root zone is deep. The water erosion hazard is severe and the soil blowing hazard is moderate.

The Potter soils occupy strongly sloping to moderately steep convex crests of hills and ridges and areas along escarpments. Typically, the surface layer is brown gravelly loam about 4 inches thick. Below this, to a depth of 10 inches, is pale brown very gravelly loam that is about 25 percent calcium carbonate. Below this, to a depth of 60 inches, is very pale brown very gravelly loam (caliche) that is about 85 percent calcium carbonate. The soil is moderately alkaline throughout.

Potter soils are well drained, and surface runoff is rapid. Permeability is moderate, and available water capacity is very low. The root zone is very shallow. The water erosion hazard is severe.

Included in mapping are small areas of Amarillo, Bippus, Berda, Guadalupe, Likes, Mobeetie, Veal, and Spur soils. Also included are areas of rock outcrop along escarpments and some small areas of badland below escarpments.

The soils in this association are not suited to cultivation. They are used mainly for range (fig. 8).

This association is moderately well suited to most urban or recreation uses. The slope, corrosivity to uncoated steel, and shallow depth over bedrock of the Potter soil are the most restrictive features. These features can be overcome by proper design and careful construction.

In rangeland, the climax plant community on the Paloduro soils is a prairie dominated by mid and short grasses. Forbs make up as much as 5 percent of the vegetation. Scattered woody plants make up about 5 percent.

Blue grama makes up as much as 35 percent of the total vegetation. Sideoats grama and buffalograss together make up about 25 percent. The remaining grasses are little bluestem, silver bluestem, Wright threeawn, sand dropseed, vine-mesquite, fall witchgrass, plains bristlegrass, and hairy grama. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and penstemon. The woody vegetation includes yucca and catclaw.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues these plants too will be grazed out. The range eventually will deteriorate to pricklypear, broom snakeweed, ragweed, prairie coneflower, sand

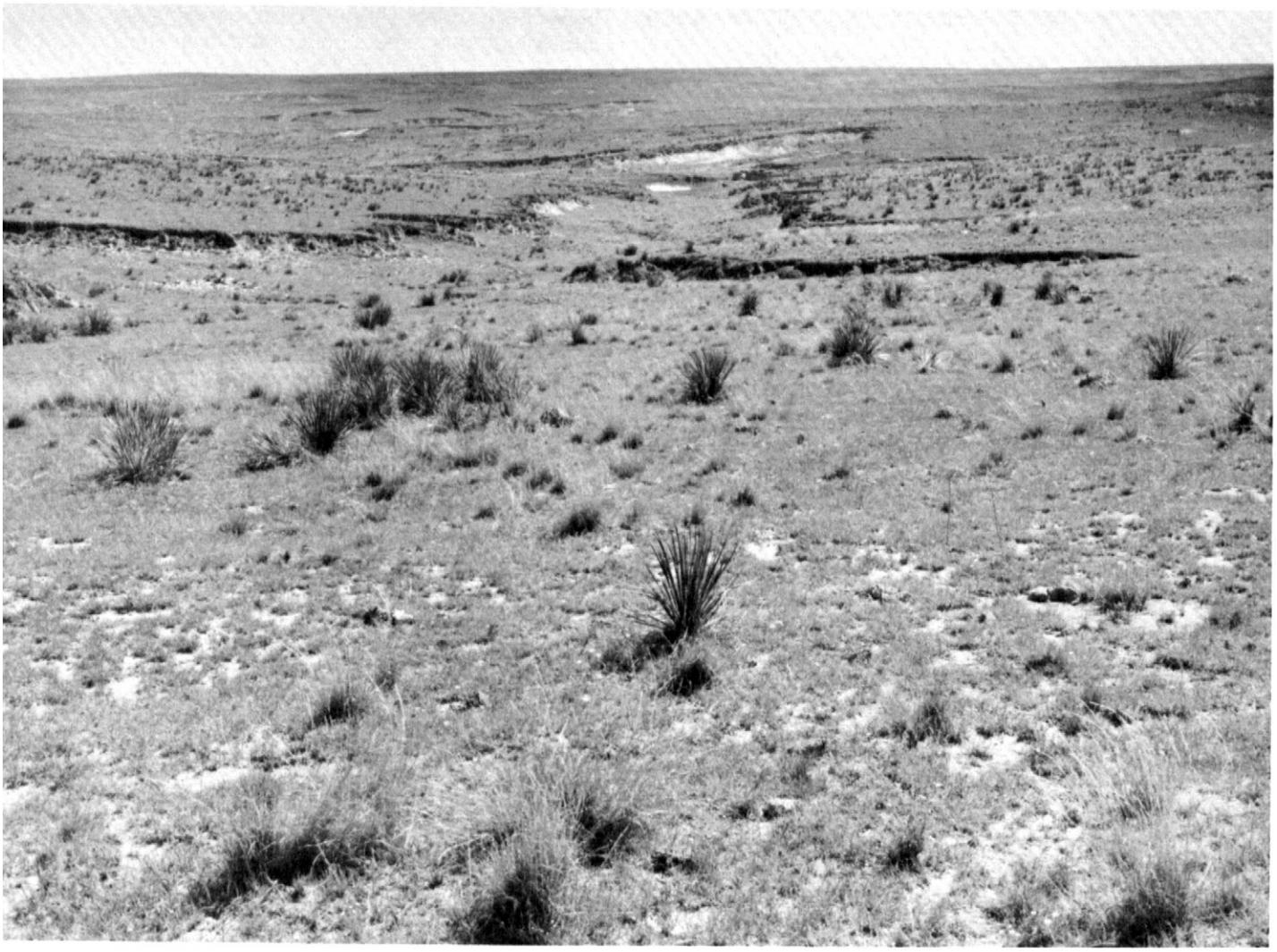


*Figure 8.—Area of Paloduro-Estacado-Potter association, rolling, in rangeland.*

dropseed, and threeawns. Mesquite is an invader in some areas.

In rangeland, the climax plant community on the Estacado soils is dominated by mid grasses. Forbs and woody plants may make up as much as 10 percent of the vegetation.

Sideoats grama, the dominant plant, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up about 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. The woody vegetation includes yucca, catclaw, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants will in turn decrease and the range will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

In rangeland, the climax plant community on the Potter soils is dominated by tall and mid grasses. Forbs make up as much as 5 percent of the vegetation. Woody plants comprise less than 10 percent.

Sideoats grama makes up about 30 percent of the total vegetation. Little bluestem and blue grama make up about 20 percent. The rest of the grasses are primarily sand bluestem, indiangrass, switchgrass, rough tridens, hairy grama, Wright threeawn, needleandthread, sand dropseed, and silver bluestem. Forbs include bigtop dalea, dotted gayfeather, black sampson, plains actinea, catclaw sensitivebrier, and ratany. The woody vegetation includes catclaw acacia, black dalea, feather dalea, skunkbush sumac, mountainmahogany, and small soapweed.

If the range is overgrazed, catclaw acacia, feather dalea, and skunkbush increase somewhat in density. Sand bluestem, indiangrass, and switchgrass may be completely replaced by shorter grasses such as hairy grama, blue grama, and threeawns. Some common invaders to this site are hairy tridens, redberry juniper, mesquite, and annual forbs and grasses.

This soil is inhabited by antelope, quail, and dove. The climax vegetation is excellent for antelope, primarily because of the forbs.

The Paloduro soils are in capability subclass VIe and the Hardland Slopes range site. The Estacado soils are in capability subclass VIe and the Loamy range site. The Potter soils are in capability subclass VIIs and the Very Shallow range site.

**31—Potter loam, 3 to 12 percent slopes.** This very shallow soil is on gently sloping to strongly sloping upland ridges. Slopes are convex and average about 6 percent. Soil areas are elongated in shape and range from 5 to 100 acres in size.

Typically, this soil has a surface layer of brown loam about 4 inches thick. Below this, to a depth of 9 inches, is pale brown gravelly loam. The underlying layer, to a depth of 20 inches, is pink platy caliche. Below this, to a depth of 66 inches, is pink loamy, massive, caliche material that is about 60 percent calcium carbonate (fig. 9). The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is medium. Permeability is moderate, and available water capacity is very low. The root zone is very shallow. The water erosion hazard is moderate.

Included in some areas of this soil are small areas of Acuff, Berda, Estacado, Mobeetie, Paloduro, and Veal soils. Also included are areas of Potter soils that have a surface layer of clay loam, gravelly loam, and fine sandy loam. There are small areas of rock outcrop.

These inclusions make up less than 25 percent of any mapped area.

This Potter soil is used mainly as rangeland. It is not suitable for cultivation.

This soil has some severe limitations for urban uses. The very shallow depth over caliche rock, slope, and corrosivity to uncoated steel are the main limiting factors. The soil is moderately well suited to recreation uses. Small stones on the surface are the most limiting factor. Slope also restricts playground uses. This soil is a good source of caliche for roadbed material.

In rangeland, the climax plant community is dominated by tall and mid grasses. Forbs make up as much as 5 percent of the vegetation. Woody plants comprise less than 10 percent.

Sideoats grama makes up about 30 percent of the total vegetation. Little bluestem and blue grama make up about 20 percent. The rest of the grasses, about 35 percent, is primarily sand bluestem, indiangrass, switchgrass, rough tridens, hairy grama, Wright threeawn, needleandthread, sand dropseed, and silver bluestem. Forbs include bigtop dalea, dotted gayfeather, black sampson, plains actinea, catclaw sensitivebrier, and ratany. The woody vegetation includes catclaw acacia, black dalea, feather dalea, skunkbush sumac, mountainmahogany, and small soapweed.

If the range is overgrazed, catclaw acacia, feather dalea, and skunkbush increase somewhat in density. Sand bluestem, indiangrass, and switchgrass may be completely replaced by shorter grasses such as hairy grama, blue grama, and threeawns. Some common invaders on this soil are hairy tridens, redberry juniper, mesquite, and annual forbs and grasses.

This soil provides habitat for quail, deer, antelope, prairie chicken, and various rodents and birds. Several of the woody shrubs on this soil are valuable browse plants for mule deer, and most of the climax forbs are eaten by antelope.

This soil is in capability subclass VIIs, nonirrigated, and the Very Shallow range site.

**32—Pullman clay loam, 0 to 1 percent slopes.** This deep, nearly level soil occupies smooth, broad uplands. Surfaces are plane and slopes average about 0.5

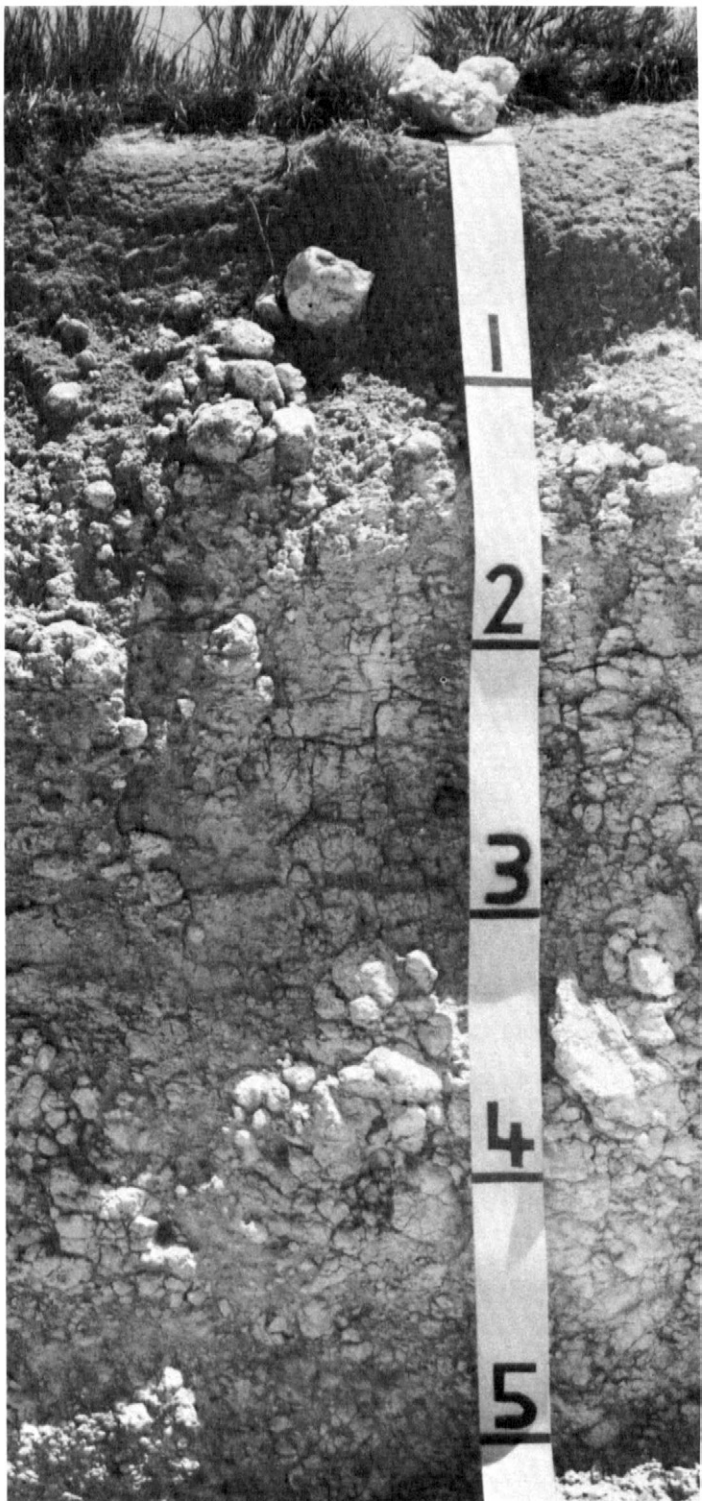



*Figure 9.—Typical profile of Potter loam, 3 to 12 percent slopes. The caliche material below a depth of about 1 foot is used locally in the construction of roadbeds. Measure is in feet.*

percent. Most areas are broad and range from 20 to more than 1,000 acres in size. The relief is so low and the land surface is so smooth that the boundary of this soil is difficult to recognize.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil, to a depth of 24 inches, is dark brown clay; below this, to a depth of 50 inches, it is reddish brown clay. The lower part of the subsoil, to a depth of 64 inches, is yellowish red clay loam that is about 20 percent calcium carbonate; below this, to a depth of 80 inches, it is reddish yellow clay loam that is about 35 percent calcium carbonate. The soil is neutral in the surface layer and moderately alkaline below.

This soil is well drained, and surface runoff is slow. Permeability is very slow, and available water capacity is high. The root zone is deep, but plant roots have some difficulty in penetrating the clayey subsoil. The water erosion hazard is slight, and the soil blowing hazard is slight.

Included in some areas of this soil are small areas of Darrouzett, Estacado, Olton, and Randall soils. Also included are small areas of Pullman silty clay loam, gently sloping Pullman clay loam, and a soil similar to the Pullman soil but which has accumulation of carbonate below a depth of 60 inches. These inclusions make up less than 15 percent of any mapped area.

This Pullman soil is used as both cropland and rangeland. Grain sorghum (fig. 10) and wheat are the main crops.

This soil is moderately well suited to nonirrigated and irrigated crops. The very slow permeability, the clayey subsoil, and surface crusting are the most limiting factors. Crop residues should be kept on the soil surface to help control soil blowing and to conserve moisture (fig. 11). Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary. Both sprinkler and surface irrigation systems are suitable. If a surface system is used, land leveling may be necessary.

This soil is moderately well suited to most urban uses. Shrinking and swelling with changes in moisture and corrosivity to uncoated steel are the main limiting factors. These are difficult to overcome by design and installation procedures. The soil is moderately well suited to recreation uses. Very slow permeability is the most limiting factor.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite together make up another 20 percent. Silver bluestem,

*Figure 10.—Minimum tillage on Pullman clay loam, 0 to 1 percent slopes. Grain sorghum is planted into standing wheat stubble.*

*Figure 11.—Corn residue left on the surface helps reduce erosion and conserve moisture on Pullman clay loam, 0 to 1 percent slopes.*

Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIs, irrigated. It is in the Clay Loam range site.

**33—Pullman clay loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on smooth uplands. Slopes are slightly convex or concave and average about 1.5 percent. Soil areas are elongated in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 7 inches thick. The subsoil, to a depth of 14 inches, is dark grayish brown clay; below this, to a depth of 30 inches, it is reddish brown clay. The lower part of the subsoil, to a depth of 58 inches, is reddish brown clay loam; below this, to a depth of 80 inches, it is yellowish red clay loam that is about 25 percent calcium carbonate. The soil is neutral in the surface layer and moderately alkaline below.

This soil is well drained, and surface runoff is medium. Permeability is very slow, and available water capacity is high. The root zone is deep, but plant roots have

difficulty in penetrating the clayey subsoil. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Included in some areas of this soil are small areas of Darrouzett, Estacado, Olton, and Randall soils. Also included are some small areas of a soil similar to the Pullman soil but which has no distinct accumulation of carbonate above a depth of 60 inches; some areas of Pullman silty clay loam; and areas of nearly level Pullman soils. These inclusions make up less than 25 percent of any mapped area.

This Pullman soil is used as both cropland and rangeland. Grain sorghum and wheat are the main crops.

This soil is moderately well suited to nonirrigated and irrigated crops. The slope, surface crusting, susceptibility to water erosion, very slow permeability, and clayey subsoil are the most limiting factors. Crop residues should be kept on the surface to help control water erosion and soil blowing and to conserve moisture. Contour farming and terraces are also needed to help control water erosion. Diversion terraces may be needed to control runoff water from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary. Both sprinkler and surface irrigation systems are suitable. If a surface system is used, however, bench leveling is necessary.

This soil is moderately well suited to most urban uses. Shrinking and swelling with changes in moisture, corrosivity to uncoated steel, and very slow permeability are the main limiting factors. These can be overcome by proper design and careful construction. This soil is moderately well suited to recreation uses. The very slow permeability and slope, in some places, are the most limiting factors.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is about 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIIe, nonirrigated, and IIIe, irrigated. It is in the Clay Loam range site.

**34—Randall clay.** This deep, nearly level soil occupies bottoms of playas, or shallow intermittent depressions. Slopes are less than 1 percent and mostly less than 0.5 percent. The surrounding plains range from 2 to 50 feet higher in elevation than the playa bottoms. Soil areas are circular to oval and range from 5 to 100 acres in size. In undisturbed areas, the surface is characterized by gilgai microrelief (moundy) consisting of microknolls and microdepressions. The microknolls, which are 6 to 20 inches higher than the bottoms of the microdepressions, are 2 to 10 feet across and from 3 to 20 feet apart. This microrelief is no longer apparent, however, in areas that have been cultivated for several years.

Typically, the surface layer is dark gray silty clay about 5 inches thick. The subsoil, to a depth of 34 inches, is dark gray clay. Below this, to a depth of 80 inches, it is grayish brown clay. The soil typically is mildly alkaline to a depth of about 34 inches and moderately alkaline below that.

This soil is somewhat poorly drained. Runoff water from surrounding soils causes ponding to a depth of a few inches to several feet. This occurs each year for periods of a few days to several months. When dry, this soil has wide cracks at the surface that extend several feet deep. Water enters the soil rapidly when it is dry and cracked, but very slowly when it is wet and the cracks are sealed by soil swelling. Permeability is very slow, and the available water capacity is high. The root zone is deep, but clay content tends to impede the movement of air, water, and roots. The soil blowing hazard is moderate.

Included in mapping are some narrow gently sloping areas around the edges of the playas. Also included are soils similar to the Randall soil but which have brownish colors within 16 inches of the surface. A few areas have been drained and are not ponded. These inclusions make up less than 5 percent of any mapped area.

This soil is used mainly as rangeland. It is not suitable for crops because of the flooding hazard.

This soil has severe limitations for urban or recreation uses. The flooding, shrinking and swelling with changes in moisture, and corrosivity to uncoated steel are the most restrictive features.

In rangeland, the climax plant community varies among playas according to their size and inundation period. The primary vegetation is short and mid grasses, sedges, and forbs. The smaller playas generally support western wheatgrass. The larger playas, which are flooded longer, primarily support sedges and rushes along with 10 to 12 species of annual grasses and forbs. The vegetation averages about 75 percent grass and 25 percent forbs.

On the average, western wheatgrass and spike sedge are the main plants and make up as much as 60 percent

of the plant community. Buffalograss, blue grama, and knotgrass make up about 15 percent of the grasses. Forbs include smartweed, arrowhead, slimleaf goosefoot, beakpod eveningprimrose, bur ragweed, kochia, and fleabane.

Vegetative changes are caused mainly by the periodic inundations, along with some effects from overgrazing. Buffalograss and blue grama increase dramatically during dry periods. Annual grasses such as little barley, barnyardgrass, and sixweeks fescue invade the site along with a variety of forbs. During prolonged flooding, buffalograss and blue grama are drowned out and western wheatgrass, sedges, and rushes increase. When the water evaporates following prolonged flooding, sedges and rushes decrease rapidly and western wheatgrass increases rapidly. Under continued dry conditions buffalograss and blue grama again increase slowly.

This soil provides habitat for quail, dove, and pheasant. When the soil is flooded, shore birds and migratory waterfowl frequent this site. Most of the forbs on this soil produce food and limited cover for these animals.

This soil is in capability subclass VIw, nonirrigated, and the Lakebed range site.

**35—Spur clay loam, occasionally flooded.** This deep, nearly level soil is on bottom lands. Slopes average about 0.4 percent. Soil areas are elongated, mostly less than 800 feet wide, and lie along creeks and streams. This soil is flooded for a few hours about once in 1 to 5 years.

Typically, the surface layer to a depth of about 14 inches, is dark brown clay loam that grades with depth to dark grayish brown. The upper part of the subsoil, to a depth of 30 inches, is brown, clay loam. The lower part of the subsoil, to a depth of 38 inches, is light yellowish brown fine sandy loam. The underlying layer, to a depth of 80 inches, is light yellowish brown loam. The soil is moderately alkaline throughout.

This soil is well drained, and surface runoff is slow. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The soil blowing hazard is slight.

Included in mapping are some small areas of Bippus, Guadalupe, Lincoln, and Sweetwater soils. These inclusions make up less than 20 percent of any mapped area.

This soil is used as both cropland and rangeland. Grain sorghum, wheat, and alfalfa are the main crops.

The soil is well suited to nonirrigated and irrigated crops. Occasional flooding is the most limiting factor. Crop residues should be kept on the soil surface to help control soil blowing and to conserve moisture. Diversion terraces may be needed to control runoff water from adjacent slopes. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are necessary. Both sprinkler and surface irrigation systems are suitable. If a surface system is used, however, land leveling may be necessary.

The flood hazard is a severe limitation for most urban and recreation uses.

The climax plant community is mainly mid and short grasses with a small amount of woody vegetation and forbs. The vegetation by weight is about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

Vine-mesquite, blue grama, sideoats grama, buffalograss, and western wheatgrass make up about 70 percent of the vegetation. About 20 percent is tall dropseed, silver bluestem, and threeawns. Forbs include prairie-clover, roundhead lespedeza, ground plum, milkvetch, Illinois bundleflower, heath aster, scarlet gaura, western ironweed, Englemann-daisy, Louisiana sagewort, and pitchersage. Woody vegetation includes cottonwood, hackberry, willows, wild plum, and elm.

If the range is overgrazed, the mid grasses give way to short grasses. Grasses such as vine-mesquite and sideoats grama are replaced by blue grama and buffalograss. With continued abuse these plants will be replaced by threeawns and silver bluestem. Eventually annuals are prevalent.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Several of the forbs, woody plants, and grasses that grow on this soil provide good cover, browse, and seeds for birds and animals.

This soil is in capability subclass IIw, nonirrigated, and IIw, irrigated. It is in the Draw range site.

**36—Sweetwater silty clay loam.** This deep, nearly level to gently sloping soil is on wet bottom lands. Slopes are slightly concave. They range from 0 to 3 percent and average about 0.8 percent. Soil areas are elongated in shape and range from 20 to 120 acres in size. This soil floods from as often as 5 times a year to once in 3 years. An apparent water table is present at a depth of 6 to 36 inches during the summer months. This soil is usually ponded from December to March.

Typically, the surface layer to a depth of about 18 inches is dark gray silty clay loam that grades to gray in the lower part. The underlying layer, to a depth of 24 inches, is light brownish gray sandy clay loam; below this, to a depth of 80 inches, is light brownish gray loamy fine sand. The soil is moderately alkaline throughout.

This soil is poorly drained, and surface runoff is slow. Permeability is moderately slow, and available water capacity is medium. The root zone is somewhat limited by the depth of the water table, which fluctuates mostly between depths of 6 and 36 inches. The soil blowing hazard is slight.

Included in mapping are small areas of Guadalupe, Likes, Lincoln, Spur, and Tivoli soils. Also included are small areas of Sweetwater soils that have 3 to 5 percent slopes; a soil similar to the Sweetwater soil but which is clay loam below a depth of 30 inches; and another soil

that has a light-colored surface layer. These inclusions make up as much as 20 percent of some mapped areas.

This soil is used mostly as hayland and rangeland. Wetness caused by the high water table is the most limiting factor.

This soil is poorly suited to urban and recreation uses. Wetness and flooding are the main limiting factors.

In rangeland, the climax plant community is dominated by tall and mid grasses. Grasses make up about 90 percent of the vegetation, forbs 5 percent, and shrubs and trees 5 percent.

Switchgrass, indiangrass, sand bluestem, western wheatgrass, and sedges and rushes make up as much as 60 percent of the total vegetation. Sedges, eastern gamagrass, prairie cordgrass, and tall dropseed are on areas where the water table is higher. The rest of the grasses are little bluestem, sideoats grama, Canada wildrye, vine-mesquite, alkali sacaton, and meadow dropseed. Forbs include roundhead lespedeza, prairie-clover, heath aster, western ironweed, pitchersage, trailing wildbean, Engelmann-daisy, Louisiana sagewort, and Illinois bundleflower. The woody vegetation includes cottonwood, willows, hackberry, elm, and bumelia.

If the range is overgrazed, the tall grasses give way to mid grasses such as sideoats grama and vine-mesquite. Further range deterioration causes a loss of these grasses and an increase in sedges and rushes. In some places, where the soil is saline, inland saltgrass and saltcedar take over.

This soil provides habitat for deer, squirrel, turkey, quail, and dove. Several of the woody plants, forbs, and grasses that grow on this soil provide good cover, browse, and seeds for birds and animals.

This soil is in the capability subclass Vw, nonirrigated, and the Wet Bottomland range site.

**37—Texroy loam, 0 to 1 percent slopes.** This deep, nearly level soil is on terraces along major streams. It occasionally receives runoff water from adjoining higher soils. Surface slopes average about 0.6 percent. Soil areas are long and narrow and range from 20 to 200 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The upper part of the subsoil, to a depth of 24 inches, is dark grayish brown loam; below this, to a depth of 65 inches, is brown loam. The lower part of the subsoil, to a depth of 80 inches, is brown fine sandy loam. The soil is typically neutral in the surface layer and moderately alkaline below.

This soil is well drained, and surface runoff is slow. Permeability is moderate, and available water capacity is high. The root zone is deep and easily penetrated by plant roots. The water received from runoff does not cause flooding and is generally beneficial to crops or grasses. Water and soil blowing hazards are slight.

Included in mapping are small areas of Acuff, Bippus, Guadalupe, Lincoln, Paloduro, and Spur soils. Also included are small areas of Texroy soils, 1 to 3 percent slopes; narrow stream channels; U-shaped gullies; and a few areas of frequently flooded Texroy soils. These inclusions make up less than 15 percent of any mapped area.

This soil is used as both cropland and rangeland. Wheat, grain sorghum, and alfalfa are the main crops.

This soil is well suited to nonirrigated and irrigated crops. Crop residues should be left on the surface to protect the soil from blowing and conserve moisture. Diversion terraces may be needed to control excess water from adjacent slopes. Fertilizer is needed when this soil is irrigated. A well designed irrigation system and proper application of water are essential. Both sprinkler and surface irrigation systems are suitable.

This soil is moderately well suited to urban and recreation uses. A few areas may need protection from runoff water from the adjoining slopes.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite together make up another 20 percent. Siver bluestem, Wright threeawn, and sand dropseed make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss. Mesquite is an invader in some areas.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIc, nonirrigated, and class I, irrigated. It is in the Clay Loam range site.

**38—Texroy loam, 1 to 3 percent slopes.** This deep, gently sloping soil is on terraces along major streams. It occasionally receives runoff water from the adjacent upland soils. Slopes average about 1.5 percent. Soil areas are elongated.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The upper part of the subsoil, to a depth of 16 inches, is dark grayish brown clay loam; below this, to a depth of 25 inches, it is dark brown clay loam. The lower part of the subsoil, to a depth of 66 inches, is light brown clay loam. The underlying layer, to a depth of 75 inches, is pink clay loam. The soil is neutral in the surface layer and moderately alkaline below.

This soil is well drained, and runoff is medium. Permeability is moderate, and available water capacity is

high. The root zone is deep and easily penetrated by plant roots. The water and soil blowing hazards are slight.

Included in mapping are small areas of Acuff, Bippus, Guadalupe, Likes, Lincoln, Mobeetie, Paloduro, and Spur soils. Also included are small areas of nearly level Texroy soils, frequently flooded Texroy soils, and a few U-shaped gullies. These inclusions make up less than 20 percent of any mapped area.

This soil is used as both cropland and rangeland. Grain sorghum, wheat, and alfalfa are the main crops.

This soil is well suited to nonirrigated and irrigated crops. Keeping crop residues on the surface will conserve moisture and help to prevent water erosion and soil blowing. Diversion terraces and grassed waterways will help to control excess runoff water from adjacent slopes. Contour farming and terraces are needed to control runoff water. Irrigated crops need to be fertilized. A well designed irrigation system and proper application of water are essential. Both surface and sprinkler irrigation systems can be used. If a surface system is used, however, bench leveling is necessary.

This soil is moderately well suited to urban and recreation uses. Slope, in some places, is an adverse factor.

In rangeland, the climax plant community is a short grass prairie with a few forbs. Very little woody vegetation grows on this soil. The vegetation by weight is about 95 percent grasses and 5 percent forbs.

Blue grama makes up about 50 percent of the vegetation. Buffalograss makes up about 20 percent; sideoats grama, western wheatgrass, and vine-mesquite make up another 20 percent. Silver bluestem, Wright threeawn, sand dropseed, and tobosa make up the rest of the grasses. Forbs include wild alfalfa, dotted gayfeather, western ragweed, trailing wildbean, and wild buckwheat.

If the range is overgrazed, sideoats grama is grazed out first. Blue grama decreases while buffalograss increases to equal or exceed the amount of blue grama. If heavily grazed, it is typical of blue grama plants to spread into a low carpet, or sod. In this weakened condition, blue grama produces about the same amount of forage as buffalograss.

Bobwhite quail, blue quail, and dove use the vegetation for food and cover. Pronghorn antelope graze the range.

This soil is in capability subclass IIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

**39—Tivoli fine sand.** This deep, sandy soil is on uplands. The topography is duned with complex short slopes of 3 to 30 percent. Soil areas are oblong in shape and range from 5 to 150 acres in size.

Typically, the surface layer is brown fine sand about 7 inches thick. The underlying layer, to a depth of 16 inches, is light brown fine sand; below this, to a depth of 80 inches, is pink fine sand. The soil is typically neutral in the surface layer and mildly alkaline below.

This soil is excessively drained, and the surface runoff is very slow. Permeability is rapid, and available water capacity is very low. The root zone is deep and easily penetrated by plant roots. The water erosion hazard is slight, and the soil blowing hazard is severe.

Included in mapping are small areas of Amarillo, Devol, Likes, Lincoln, Mobeetie, Tascosa, and Veal soils, and Tivoli loamy fine sand. A few small blowout pits occur in most areas, and a few areas of barren, active dunes occur in a few of the larger areas. These inclusions make up less than 20 percent of any mapped area.

This soil is used as rangeland. It is not suited to cultivation. The severe soil blowing hazard is the most limiting factor.

This soil is moderately well suited to urban and recreation uses. Rapid permeability, slope, and the sandy texture are the main limiting factors.

In rangeland, the climax plant community is a prairie dominated by tall grasses. Forbs and woody shrubs are abundant. The vegetation by weight is 75 percent grass, 15 percent woody vegetation, and 10 percent forbs.

Little bluestem, sand bluestem, and indiangrass make up as much as 45 percent of the total vegetation. About 30 percent of the grass vegetation is switchgrass, sand lovegrass, Canada wildrye, sand dropseed, giant dropseed, needleandthread, silver bluestem, Texas bluegrass, big sandreed, sideoats grama, hairy grama, blue grama, threeawns, and sand paspalum. Forbs include lead plant, mentzelia, wild alfalfa, prairie-clover, and catclaw sensitivebrier. Woody vegetation includes shinnery oak, sand sagebrush, sand plum, skunkbush sumac, and small soapweed.

If the range is overgrazed, tall grasses such as sand bluestem and little bluestem are grazed out first. Threeawns, sand dropseed, fall witchgrass, red lovegrass, and tumble windmillgrass increase. Shinnery oak and sand sagebrush also increase and form a dense overstory.

This soil provides habitat for deer, turkey, prairie chicken, quail, and dove. Several of the woody plants, forbs, and grasses on this soil provide good cover, browse, and seeds for game birds and animals.

This soil is in capability subclass VIIe, nonirrigated. It is in the Sand Hills range site.

**40—Veal loam, 1 to 5 percent slopes.** This deep, gently sloping soil is on uplands. Slopes are slightly convex and average about 3 percent. Soil areas are irregular in shape and range from 5 to 80 acres in size. Most cropland areas of this soil are slightly eroded.

Typically, the surface layer is grayish brown loam about 6 inches thick. The subsoil, to a depth of 18 inches, is brown clay loam; below this, to a depth of 35 inches, it is white clay loam that is about 60 percent calcium carbonate. The lower part of the subsoil, to a depth of 64 inches, is pink clay loam that is about 40 percent calcium carbonate. The underlying layer, to a

depth of 80 inches, is light yellowish brown clay loam. The soil is moderately alkaline throughout.

This soil is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep. The water erosion hazard is slight, and the soil blowing hazard is moderate.

Included in mapping are small areas of Acuff, Amarillo, Berda, Estacado, Mobeetie, Paloduro, Potter, and Tascosa soils, and Veal fine sandy loam. Also included are small areas of nearly level Veal soils, sloping Veal soils, and some spots and patches where most of the surface layer has been removed by erosion. These inclusions make up less than 25 percent of any mapped area.

This soil is used as cropland and rangeland. Grain sorghum and wheat are the main crops.

This soil is poorly suited to crops. Slope, susceptibility to soil blowing and water erosion, and high calcium carbonate content of the soil are the most limiting factors. The high carbonates cause chlorosis in some crops, as indicated by yellowing of the leaves. Where cropped, crop residues should be kept on the surface to help control water erosion and soil blowing and to conserve moisture. Stripcropping and field windbreaks also help prevent soil blowing. Contour farming and terraces may be needed to help control water erosion. Diversion terraces may be needed to control runoff from adjacent slopes. Grassed waterways make good outlets for diversions and terrace systems. Emergency tillage is needed to control soil blowing when crop residues do not furnish adequate protection. Fertilizer is needed when this soil is cropped. A well designed irrigation system and proper application of water are necessary if this soil is irrigated. Sprinkler, surface, and drip irrigation systems are suitable. If a surface system is used, bench leveling is necessary.

This soil is moderately well suited to most urban uses. Corrosivity to uncoated steel and slope are the main limiting factors, but these can be overcome by good design and careful construction. The soil is well suited to recreation uses.

In rangeland, the climax plant community is dominated by mid grasses. Forbs and woody plants together may make up as much as 10 percent of the vegetation.

Sideoats grama, the dominant plant, makes up as much as 35 percent of the total vegetation. Blue grama and buffalograss make up about 35 percent. The rest of the grasses are mainly little bluestem, silver bluestem, Wright threeawn, vine-mesquite, fall witchgrass, and sand dropseed. Forbs include prairie-clover, wild alfalfa, dalea, dotted gayfeather, catclaw sensitivebrier, and primrose. Woody vegetation includes yucca, catclaw acacia, black dalea, and feather dalea.

If the range is overgrazed, sideoats grama and little bluestem give way to blue grama and buffalograss. If heavy grazing continues, these plants in turn will decrease and the range will deteriorate to pricklypear, broom snakeweed, ragweed, sand dropseed, and threeawns.

This soil provides habitat for antelope, quail, and dove. The climax vegetation is excellent for antelope because of an abundance of quality forbs.

This soil is in capability subclass IVe, nonirrigated and irrigated. It is in the Loamy range site.

# use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## cultivated crops

The major management concerns in the use of the soils for crops and the irrigation practices are described in this section. In addition, the crops best suited to the soils, including some not commonly grown in the county, are identified; yields of the major crops are listed; and the system of land capability classificastion used by the Soil Conservation Service is explained.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. Planners of management systems for individual fields or farms should also consider the information given in the description of each soil in the section "Detailed soil map units." Additional information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

There is about 53,030 acres in the county being used for crops, according to the 1967 Conservation Needs Inventory (*3*). About 9,620 acres is in row crops, of which about 7,620 is irrigated. The primary row crop is grain sorghum, and there are a few acres of corn. About 28,880 acres is in wheat, of which 9,300 acres is irrigated. The county has about 3,890 acres of hayland.

The acreage in crops and pasture has remained about constant, but the amount of land irrigated is slowly declining as a result of the falling water table in the Ogallala Formation, the water-bearing strata underlying the soils of the county. Crop production on both nonirrigated and irrigated lands could be increased, however, by extending the latest crop production technology to all cropland in the county.

To plan an effective system of soil management, a farmer must know what conservation practices are suited to the soils and to the climate, how much the soils will produce, and what their limitations are.

Climate is the factor that most affects the agriculture of Roberts County. Crops suited to the soils are limited by the low, variable annual rainfall and relatively short growing season. Windstorms, occasional rains of high intensity, hail, blowing snow, and prolonged severe drought are hazards that must be considered in management. When effective, good management protects the soils against soil blowing and water erosion, conserves moisture, improves the physical condition of the soil, and maintains productivity.

Water erosion is a hazard on the Acuff, Amarillo, Darrouzett, Estacado, Mobeetie, Olton, Pullman, Texroy, and Veal soils that have a slope of more than 1 percent. The hazard is greater on longer and steeper slopes.

Terrace and contour farming shorten the slope and reduce runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. On the nearly level Acuff, Darouzett, Olton, and Pullman soils, terracing and contour farming are used to conserve

moisture. All terraces require suitable outlets to dispose of excess water. If natural grassed drainageways are not available as outlets, grassed waterways should be constructed before terraces are built.

Soil blowing is a moderate hazard on the loamy soils such as the Mobeetie, Amarillo, Bippus, Berda, and Estacado soils and on the clayey Randall soils. It is a severe problem on the sandy Likes, Tivoli, Lincoln, and Devol soils. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. The damage can be minimized by maintaining plant cover, surface mulch, and rough surfaces through proper tillage. Emergency tillage (fig. 12) may be necessary during prolonged droughts when vegetation is inadequate to protect the soil. If the surface is made cloddy or rough by chiseling or listing the impact of the wind is broken and drifting soil is trapped. Emergency tillage has only a temporary effect, and may have to be repeated during the blowing season. Windbreaks (fig. 13) of adapted shrubs and trees such as Siberian elm or eastern redcedar are effective in reducing soil blowing on cropland and around homes and gardens.

Loss of the surface layer through water erosion or soil blowing is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. This is especially damaging on soils that have a clayey subsoil, such as the Pullman soils, and on soils that have large accumulations of calcium carbonate in the upper part of the subsoil, such as the Estacado soils. Second, soil erosion on farmland results in pollution of streams and lakes by sediment and decreases the quality of water for municipal use, for recreation, and for fish and wildlife. Soil blowing can also result in pollution of the air and drifts of productive soil material deposited along fence rows, in bar ditches, and across roads.

Erosion control practices provide protective plant cover, reduce runoff, and increase infiltration. A cropping

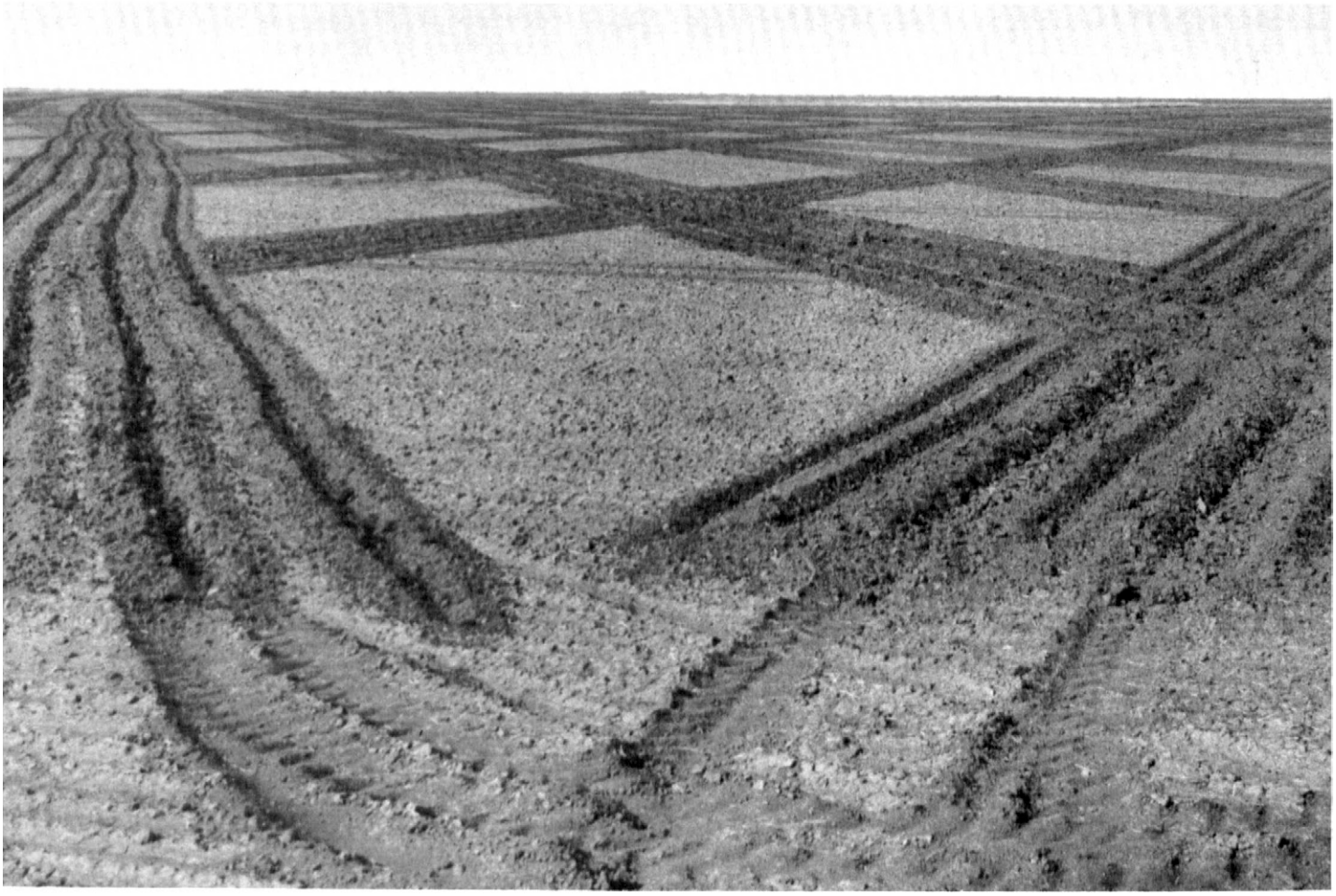


*Figure 12.—Pattern of emergency tillage to reduce soil blowing on Pullman clay loam, 0 to 1 percent slopes.*

*Figure 13.—Windbreak to reduce soil blowing on Acuff loam, 1 to 3 percent slopes.*

system that keeps a plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. Information on the design and application of erosion control practices for each kind of soil is contained in the Technical Guide available at local offices of the Soil Conservation Service.

Winter wheat and grain sorghum are the cash crops best suited to the climatic conditions of the county. Wheat is the major crop. Essentially the same cropping system can be used on irrigated cropland as on nonirrigated cropland, but better soil improvement programs can be carried out under irrigation. Under irrigation, more crops can be grown for green manure and more crop residues can be produced. Also, better use can be made of crop residues because with ample moisture it is practical to add commercial fertilizers.

Moisture, not fertility, is what limits nonirrigated crop production on the soils of Roberts County. Because about two-thirds of the total precipitation is lost through evaporation, moisture conservation must be stressed to get dependable production on all cropland soils in the county. Cropping systems that provide substantial plant cover combined with minimum tillage are needed to control erosion and conserve soil moisture. Minimizing tillage and leaving crop residues on the soil surface help

increase infiltration, reduce evaporation of soil moisture, and slow the rate of runoff. These practices can be adapted to most soils in the survey area, including the Acuff, Estacado, Darrouzett, Olton, Paloduro, Pullman, and Texroy soils.

Soil fertility is naturally high in soils such as Acuff, Bippus, Estacado, Darrouzett, Olton, Paloduro, Pullman, and Texroy soils. Some soils such as Bippus, Estacado, and Paloduro soils are calcareous and may need additions of iron to overcome the effect of chlorosis caused in some crops by the high lime content. Experimental records show that in nonirrigated cropland, crops on clayey and loamy soils do not generally respond to commercial fertilizer. However, fertilizer has proven profitable and advantageous on irrigated soils. On all soils additions of fertilizer and trace elements should be based on soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are generally friable, granular, and porous. Most of the soils used for crops in Roberts county have dark loam or clay loam surface layers that have a moderate to high content of organic matter. Tilth is a problem, however, on Olton, Pullman, and Randall soils. If these soils are wet when plowed, they tend to be very cloddy when dry and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in the spring, but soil blowing is a problem if these soils are left bare. Regular additions of crop residue, manure, and other organic material can help maintain or improve soil structure and tilth on all soils.

Field crops suited to the soils and climate of Roberts County include many that are not now commonly grown. Grain sorghum and wheat are the chief row crops. Some cotton is also grown. Corn, sunflowers, soybeans, and similar crops can be grown under irrigation. Although winter wheat is the principal close-growing crop, rye and spring seeded oats are sometimes grown for grazing or green manure crops. Special crops are not commonly grown commercially in Roberts County, but the potential is good for some vegetable and orchard crops. Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and tree fruits. Production is limited mainly by the amount of rainfall or availability of irrigation water. Special field crops such as alfalfa, barley, and sunflowers are grown, and there are numerous home vegetable gardens in the county. The latest information and suggestions for growing field crops or special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

The data about specific soils in this soil survey can be used in planning future land use patterns. Potential productive capacity for farming should be weighed against soil limitations and potential for nonfarm development.

In general, the soils in the survey area that are well suited to crops are also well suited to urban development. In some areas, however, there are soils well suited to farming but poorly suited to nonfarm development. One such area is map unit 4 on the general soil map. In this unit the dominant soil is Pullman clay loam, which has a high shrink-swell potential and low strength properties. The high shrink-swell potential is a limitation for nonfarm development and low strength is a limitation for local roads and streets. This soil, however, produces good yields of farm crops.

### irrigation

Two types of irrigation systems are used in Roberts County—furrow irrigation systems and sprinkler irrigation systems. Furrow systems are popular on the nearly level Olton, Pullman, and Darrouzett soils. They require less land leveling and maintenance than sprinkler systems. Only minor field leveling or smoothing is needed to prepare nearly level fields for furrow irrigation. Irrigation water runoff can be saved by collecting it in a tailwater pit, then pumping it back into the distribution system. Sprinkler irrigation systems are best suited to gently sloping loamy soils such as the Acuff, Amarillo, Bippus, Mobeetie, Paloduro, and Texroy soils.

Irrigation systems should be designed in accordance with the physical and chemical properties of the soil. Correct irrigation interval, rate of water application, and length of run on gravity irrigation systems are important in water management.

Although yields of irrigated crops are two to three times greater than yields of nonirrigated crops, irrigation on a large scale may be fairly short lived in Roberts County because the water supply is being depleted. Observations of irrigation wells indicate a decline of the underground water level. More efficient use of the remaining underground water and better methods of conserving rainwater are needed. Information on the design and application of irrigation systems for each kind of soil is in the Technical Guide available in field offices of the Soil Conservation Service.

### yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil

and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

### land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map units."

## rangeland

Gary R. Briggs, range conservationist, Soil Conservation Service, helped prepare this section.

About 87 percent of Roberts County is rangeland, and most of the farm income is made on livestock, principally cattle (fig. 14). Stocker operations dominate the ranching enterprises, but there are also a good number of cow-calf operations. The average ranch size is about 8,000 acres.

Soils in the southern part of the county are mainly deep, nearly level, and loamy. These soils support short grasses, and production potential is low because the clayey subsoils cause droughtiness. Most soils in the county, however, are made up of soils that have loamy or sandy subsoils. These soils are more permeable, there is less runoff, and more of the rainfall is available for plant growth. They produce mid and tall grasses. In

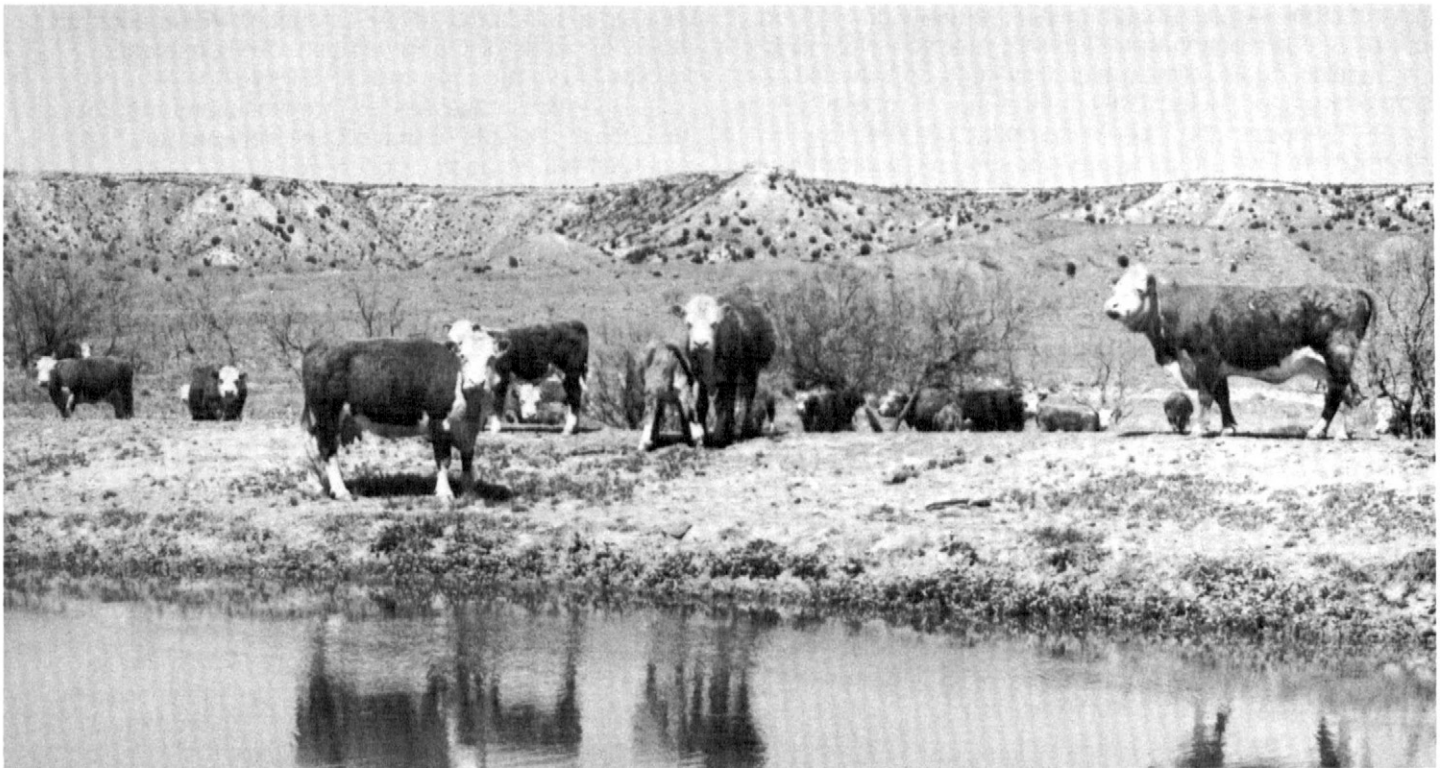


*Figure 14.—About 87 percent of Roberts County is rangeland, and most of the farm income is from livestock. This livestock pond is in the Paloduro-Estacado-Potter association, rolling.*

the northern part of the county, the wide, flat bottom lands along the Canadian River are sandy, very productive, and are producing or have the potential to produce a tall grass plant community.

Several ranches supplement the range forage with wheat, which is grazed during fall, winter, and spring when conditions are favorable. During winter months a protein supplement or hay is usually added to the native forage.

The native vegetation in many parts of the county has been greatly depleted by continued excessive use and by invasion of weedy vegetation, which further reduces range forage yields. The amount of forage currently produced may be less than half what was once produced. Productivity can be increased, however, by using management practices than are effective for specific kinds of soil and range sites.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for each soil, the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

*Potential production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conserving water, and controlling water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

## windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection (fig. 13).

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

## recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

*Camp areas* require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty

when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, switchgrass, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, croton, beggarweed, western wheatgrass, and grama.

*Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, grape, bitterbrush, wild plum, and sand sagebrush.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, blue quail, pheasant, meadowlark, field sparrow, cottontail, and antelope.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, mink, and beaver.

*Habitat for rangeland wildlife* consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, lesser prairie chicken, horned lark, jackrabbit, meadowlark, and turkey.

## engineering

Dwight G. Head and Edwin E. Davis, civil engineers, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

### building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of

gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

**sanitary facilities**

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, or depth to bedrock affect absorption of the effluent. Bedrock also interferes with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise

stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

**construction materials**

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an

appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

**water management**

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

*Aquifer-fed excavated ponds* are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture, (*4*). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

*Rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a

seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

## engineering index test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (particle index)—T 100 (AASHTO), D 653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

# classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*ust*, meaning burnt, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Paleustalfs (*Pale*, meaning old, plus *ustalf*, the suborder of the Alfisols that have a ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Paleustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic Aridic Paleustalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Amarillo series.

## soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

### Acuff series

The Acuff series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy sediment. Slopes range from 1 to 5 percent.

Typical pedon of Acuff loam, 1 to 3 percent slopes; from the intersection of Texas Highway 70 and Farm Road 282, 14.5 miles north on Texas Highway 70 and 100 feet west in rangeland:

A1—0 to 7 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak very coarse prismatic structure parting to weak fine granular; hard, friable; many very fine roots; many fine and

very fine pores; many wormcasts; neutral; clear smooth boundary.

B21t—7 to 16 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/2) moist; moderate very coarse prismatic structure parting to weak fine subangular blocky; hard, friable; common very fine roots; many medium to very fine pores; many wormcasts; few patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—16 to 30 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate very coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; few very fine roots; many fine and very fine pores; common wormcasts; patchy clay films on faces of peds; common threads and films of calcium carbonate on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.

B23t—30 to 42 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate very coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; many fine and very fine pores; few wormcasts; few patchy clay films on faces of peds; few threads and films of calcium carbonate on faces of peds; calcareous; moderately alkaline; clear smooth boundary.

B24t—42 to 56 inches; reddish yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; weak medium subangular blocky structure; very hard, friable; common medium to very fine pores; few clay films on faces of peds; about 50 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

B25tca—56 to 70 inches; pink (7.5YR 8/4) sandy clay loam, pink (7.5YR 7/4) moist; weak medium subangular blocky structure; hard, friable; common fine and very fine pores; about 60 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

B26tca—70 to 80 inches; pink (7.5YR 8/4) sandy clay loam, pink (7.5YR 7/4) moist; massive; very hard; friable; about 50 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches thick. Thickness of the mollic epipedon ranges from 11 to 20 inches. Depth to layers containing secondary carbonates is 15 to 24 inches.

The A horizon is 6 to 14 inches thick. It is dark grayish brown or dark brown.

The B2t horizon is reddish brown, yellowish red, reddish yellow, light reddish brown, or light brown. It is mildly alkaline or moderately alkaline and loam, clay loam, or sandy clay loam. The B2tca horizon is pink, light reddish brown, light brown, or reddish yellow. Texture is clay loam or sandy clay loam. These horizons are 20 to 60 percent calcium carbonate.

## Amarillo series

The Amarillo series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous material. Slopes range from 0 to 5 percent.

A typical pedon of Amarillo fine sandy loam, 1 to 3 percent slopes; from the Gray County line, 1.3 miles north on Farm Road 282, 11.6 miles north on a county road, 0.2 miles east on a private road, and 300 feet south in rangeland:

A1—0 to 10 inches; brown (7.5YR 5/2) fine sandy loam, brown (7.5YR 4/2) moist; moderate fine granular structure; slightly hard, very friable; many fine and very fine roots; many very fine pores; common wormcasts; mildly alkaline; clear smooth boundary.

B21t—10 to 30 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate coarse prismatic structure parting to moderate fine subangular blocky; hard, friable; common very fine roots; many medium to very fine pores; many wormcasts; few patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—30 to 48 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few very fine roots; common medium to very fine pores; common wormcasts; few patchy clay films on faces of peds; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B23tca—48 to 65 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few very fine roots; common very fine pores; few wormcasts; few patchy clay films on faces of peds; about 30 percent threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B24t—65 to 73 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few very fine pores; few patchy clay films on faces of peds; about 5 percent threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B25t—73 to 80 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; hard, friable; few very fine pores; few patchy clay films on ped faces; few threads, films, and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches thick. Depth to secondary carbonates is 16 to more than 40 inches.

The A horizon is 7 to 10 inches thick. It is brown or reddish brown, and neutral or mildly alkaline.

The B2t horizon above the Btca horizon is brown, light brown, reddish brown, or yellowish red. The Btca horizon is light reddish brown, reddish yellow, or light brown. The B2t horizon below the Btca horizon is reddish brown, light reddish brown, pink, yellowish red, or reddish yellow. Texture of the B2 horizon is dominantly sandy clay loam with a clay content of 20 to 35 percent.

A IIC horizon is below a depth of 60 inches in some pedons. It is light brown, yellowish red, and reddish yellow and is fine sandy loam or loamy fine sand.

## Berda series

The Berda series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy sediment of slope alluvium and colluvial valley fill. Slopes range from 20 to 45 percent.

Typical pedon of Berda soil in an area of Berda-Potter-association, steep; from U.S. Highway 60 in Miami, 3.2 miles northwest on Farm Road 283, and 50 feet east in rangeland:

A1—0 to 10 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate very fine subangular blocky structure; hard, friable; common roots; common wormcasts; few caliche rock fragments; calcareous; moderately alkaline; clear smooth boundary.

B2—10 to 24 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; common fine roots; common fine pores; common wormcasts; few caliche rock fragments up to 1 inch in diameter; calcareous; moderately alkaline; clear smooth boundary.

B2ca—24 to 42 inches; pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few fine pores; few wormcasts; few caliche fragments up to 1 inch diameter; about 5 percent by volume threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—42 to 60 inches; pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable; caliche rock fragments up to 1 inch in diameter; few threads and films of calcium carbonate; calcareous; moderately alkaline.

The solum thickness ranges from 40 to more than 60 inches.

The A horizon is 6 to 12 inches thick. It is grayish brown, brown, or pale brown and fine sandy loam, loam, or clay loam.

The B2 and B2ca horizons are brown or pale brown, light yellowish brown, or pink. They are loam, clay loam, or sandy clay loam with a clay content of 18 to 35 percent. Calcium carbonate content of the B2ca horizon varies from 1 to 20 percent.

The C horizon is pink, light brown, or very pale brown. Texture is fine sandy loam, loam, sandy clay loam, or clay loam.

## Bippus series

The Bippus series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous loamy outwash on concave uplands near draws and creeks. Slopes range from 0 to 3 percent.

Typical pedon of Bippus clay loam, 1 to 3 percent slopes; from the Canadian River Bridge, 0.3 miles north on Texas Highway 70 to county road, 14.5 miles east to a private road, north 0.2 miles, and 50 feet east in rangeland:

A11—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; hard, friable; many very fine pores; many wormcasts; many fine and very fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

A12—6 to 27 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate fine subangular blocky; hard, friable; many fine and very fine pores; many wormcasts; many very fine roots; few threads and films of calcium carbonate below a depth of 18 inches; few caliche pebbles up to 1 cm in diameter; calcareous; moderately alkaline; gradual smooth boundary.

B21—27 to 45 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; many fine and very fine pores; common wormcasts; common threads and films of calcium carbonate; few caliche pebbles up to 1 cm in diameter; calcareous; moderately alkaline; gradual smooth boundary.

B22—45 to 60 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; very hard, friable; many fine and very fine pores; common wormcasts; many films and threads of calcium carbonate; few caliche pebbles up to 1 cm diameter; calcareous; moderately alkaline; gradual smooth boundary.

B23—60 to 80 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; very hard, friable; common very fine pores; common films and threads of calcium carbonate; few caliche pebbles up to 1 cm in diameter; calcareous; moderately alkaline; abrupt smooth boundary.

The solum thickness exceeds 65 inches. Thickness of the A horizon and mollic epipedon is 20 to 35 inches. Texture is clay loam or fine sandy loam and is mildly alkaline or moderately alkaline. Colors are dark grayish brown or brown.

The B21 horizon is clay loam or sandy clay loam, and dark grayish brown, grayish brown, brown, or pale brown. The B22 horizon is clay loam or sandy clay loam. It is brown, pale brown, light brown, pink, or reddish yellow. The B23 horizon, where present, is clay loam or sandy clay loam, and is dark grayish brown, grayish brown, brown, light brown, or pink. Calcium carbonate content varies from barely visible films or threads to about 5 percent of soft bodies by volume.

## Darrouzett series

The Darrouzett series consists of deep, well drained, loamy soils on uplands. These soils have formed in loamy calcareous material mostly of eolian origin. Slopes range from 0 to 1 percent.

Typical pedon of Darrouzett silty clay loam, 0 to 1 percent slopes; from the intersection of Farm Roads 282 and 283 northwest of Miami, 9.4 miles west on Farm Road 282, 1.5 miles south on a county road, and 50 feet west in cropland:

Ap—0 to 7 inches, dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable; neutral; abrupt smooth boundary.

B21t—7 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, firm; common very fine roots, many very fine pores; few wormcasts; few patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.

B22t—17 to 28 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium blocky structure; very hard, very firm; few very fine roots; few very fine pores; patchy clay films on faces of peds; calcareous below 22 inches; moderately alkaline; gradual smooth boundary.

B23t—28 to 40 inches; dark brown (7.5YR 4/3) silty clay loam, dark brown (7.5YR 3/3) moist; moderate medium blocky structure; very hard, firm; few very fine roots; common very fine pores; patchy clay films on faces of peds; few threads, films, and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B24t—40 to 52 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate fine and medium blocky structure; very hard, firm; common very fine pores; patchy clay films on faces of peds; few threads, films, and a few very fine soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B25tca—52 to 66 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine and medium blocky structure; hard, firm; many fine and very fine pores; patchy clay films on faces of peds; about 25 percent by volume threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B26tca—66 to 80 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; moderate medium blocky structure; very hard, firm; common very fine pores; patchy clay films on faces of peds; about 10 percent by volume threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline.

The mollic epipedon is 25 to 30 inches thick. Depth to secondary calcium carbonates is 17 to 28 inches. A calcic horizon is at a depth of 50 to 61 inches.

The A horizon is 7 to 12 inches thick and is brown or dark grayish brown. Reaction is neutral to moderately alkaline.

The Bt horizon is silty clay loam, clay, or clay loam with 35 to 45 percent clay. The B21t and B22t horizons are brown, dark grayish brown, or reddish brown. The B23t and B24t horizons are brown, dark brown, reddish brown, reddish yellow, or pink. The B25tca and B26tca horizons are brown, yellowish red, light brown, reddish yellow, or pink. Calcium carbonate content of the Btca is 10 to 30 percent, mostly in soft powdery forms.

## Devol series

The Devol series consists of deep, well drained, sandy soils on uplands. These soils formed in sandy and loamy alluvial sediment that has been modified by wind. Slopes range from 3 to 8 percent.

Typical pedon of Devol loamy fine sand, 3 to 8 percent slopes; from the intersection of U.S. Highway 70 and Farm Road 282, 11 miles north on U.S. Highway 70 to a county road, 7 miles northwest on the county road to a private road, 1 mile west on the private road, and 100 feet north in rangeland:

A1—0 to 12 inches; brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) moist; weak fine granular structure; soft, loose; common very fine roots; neutral; clear smooth boundary.

B2t—12 to 24 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable; common very fine roots; few clay films on faces of peds; neutral; clear smooth boundary.

B3—24 to 44 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, loose; few very fine roots; mildly alkaline; gradual smooth boundary.

C—44 to 50 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; massive; soft, loose;

few very fine roots; mildly alkaline; abrupt smooth boundary.

Ab—50 to 58 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak very fine subangular blocky structure; slightly hard, very friable; common very fine pores; few very fine roots; moderately alkaline; clear smooth boundary.

Btb—58 to 80 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate very coarse prismatic structure parting to weak fine subangular blocky; hard, friable; common wormcasts; many fine and very fine pores; few patchy clay films on faces of peds; few threads and films of calcium carbonate; calcareous; moderately alkaline.

The solum is 35 to 49 inches thick.

The A horizon is brown or light brown, and neutral or mildly alkaline.

The B2t horizon is brown, reddish brown, or light reddish brown and is neutral or mildly alkaline. The B3 horizon is yellowish red, reddish brown, or reddish yellow. It is fine sandy loam or loamy fine sand and is neutral to moderately alkaline.

The C horizon is reddish yellow, brown, light brown, or reddish yellow. It is mildly or moderately alkaline. Some pedons have a buried soil below a depth of 50 inches that is fine sandy loam, loam, or sandy clay loam and darker than the overlying horizons.

Because of the buried horizons and thinner solum, the Devol soils in Roberts County are considered taxadjuncts to the Devol series. However, there is no difference in use, behavior, or management.

## Estacado series

The Estacado series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy sediment. Slopes range from 0 to 16 percent.

Typical pedon of Estacado clay loam, 3 to 5 percent slopes; from the intersection of Farm Roads 283 and 282, east 400 feet to a private road, 1.6 miles north, and 200 feet east in rangeland:

A1—0 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; hard, friable; common very fine roots; many very fine pores; many wormcasts; calcareous; moderately alkaline; clear smooth boundary.

B21tca—11 to 18 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate coarse prismatic structure parting to moderate fine subangular blocky; very hard, friable; common very fine roots; many very fine pores; common wormcasts; patchy clay films on faces of peds; about 10 percent by volume threads, films, and very fine soft bodies of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B22tca—18 to 30 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium and fine blocky structure; very hard, firm; few very fine roots; many fine and very fine pores; few patchy clay films on faces of peds; about 20 percent threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B23tca—30 to 45 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate fine blocky structure; very hard, friable; common very fine pores; few patchy clay films on faces of peds; about 50 percent medium to very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B24tca—45 to 62 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, firm; common fine and very fine pores; few patchy clay films on faces of peds; about 20 percent by volume medium to very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B25tca—62 to 80 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium blocky structure; hard, firm; many very fine pores; few patchy clay films on ped faces; few very fine black stains (iron-manganese) on faces of peds; about 20 percent by volume medium to very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is brown, or dark grayish brown.

The B2t horizon is reddish brown, brown, light brown, light reddish brown, reddish yellow, yellowish red, or pink. They are clay loam or sandy clay loam. Visible carbonates range from 10 to 15 percent in the B21tca horizon, increase to 20 to 50 percent in the B22tca horizon, then decrease in the lower part of the B2tca horizon.

## Guadalupe series

The Guadalupe series consists of deep, well drained, loamy soils on bottom lands. These soils formed in loamy, calcareous alluvium. Slopes are 0 to 1 percent.

Typical pedon of Guadalupe fine sandy loam, occasionally flooded; from the Canadian River Bridge on Texas Highway 70, south 4.0 miles, 2.8 miles southeast on Farm Road 283, .4 miles northeast on private road, 700 feet southeast on private road, and 150 feet east near the south bank of the creek:

A11—0 to 6 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; few wormcasts;

calcareous; moderately alkaline; abrupt smooth boundary.

A12—6 to 11 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak very fine subangular blocky structure; hard, friable; common medium to very fine pores; few wormcasts; calcareous; moderately alkaline; abrupt smooth boundary.

B21—11 to 16 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine and very fine pores; common wormcasts; few thin strata of loam and very fine sandy loam; calcareous; moderately alkaline; abrupt smooth boundary.

B22—16 to 26 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak very fine subangular blocky structure; slightly hard, very friable; common fine and very fine pores; common wormcasts; few thin strata of loam and loamy fine sand; calcareous; moderately alkaline; abrupt smooth boundary.

B23—26 to 36 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable; few medium to very fine pores; few wormcasts; few very thin strata of clay loam and very fine sandy loam; calcareous; moderately alkaline; abrupt smooth boundary.

B24—36 to 45 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; common very fine pores; few wormcasts; faint bedding planes; common strata of pale brown clay loam; few threads and films of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

B3—45 to 50 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak very fine subangular blocky structure; slightly hard, very friable; few very fine roots; faint bedding planes; calcareous; moderately alkaline; abrupt smooth boundary.

C—50 to 80 inches; stratified pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; and very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; moderate very fine subangular blocky structure; very hard, friable; common very fine pores; faint bedding planes; few threads and films of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

Thickness of the solum ranges from 32 to 55 inches deep.

The A horizon is grayish brown or brown.

The B horizon is pink, grayish brown, brown, pale brown, or light yellowish brown. It is fine sandy loam, very fine sandy loam, or loam with strata of clay loam and loamy fine sand.

The C horizon is light brown, pink, pale brown, very pale brown, or light yellowish brown. It is stratified loam to loamy fine sand.

## Likes series

The Likes series consists of deep, excessively drained, sandy soils on uplands. These soils formed in sandy calcareous material. Slopes range from 1 to 30 percent.

Typical pedon of Likes loamy fine sand, 1 to 8 percent slopes; from the Hemphill County line on the north side of the Canadian River, 1.3 miles west on county road, and 100 feet south in rangeland:

A1—0 to 10 inches; brown (7.5YR 5/2) loamy fine sand, brown (7.5YR 4/2) moist; weak granular structure; soft, very friable; common fine and very fine roots; calcareous; moderately alkaline; clear smooth boundary.

C1—10 to 22 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; few very fine roots; calcareous; moderately alkaline; clear smooth boundary.

C2—22 to 80 inches; pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose; few very fine roots; calcareous; moderately alkaline.

Depth to free carbonates is 3 to 40 inches.

The C horizon is brown, light brown, pale brown, light yellowish brown, light brown, or pink. It is loamy fine sand or fine sand.

## Lincoln series

The Lincoln series consists of deep, somewhat excessively drained, sandy soils on bottom lands. These soils formed in sandy, calcareous alluvium. Slopes range from 0 to 1 percent.

Typical pedon of Lincoln fine sand, frequently flooded; from the south end of the Canadian River Bridge on Texas Highway 70, and 200 feet east in rangeland:

A1—0 to 12 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; weak fine granular structure; soft, loose; few very fine roots; calcareous; moderately alkaline; clear smooth boundary.

C1—12 to 40 inches; pink (7.5YR 7/4) loamy fine sand, brown (7.5YR 5/3) moist; single grained; loose; few very fine roots; very thin to 1/4-inch thick strata of darker fine sandy loam and loam; calcareous; moderately alkaline; clear wavy boundary.

C2—40 to 80 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; very thin to 1/4-inch thick strata of darker fine sandy loam to clay loam; calcareous; moderately alkaline.

The A horizon is brown, pale brown, very pale brown, or yellowish brown.

The C horizon is pink, light brown, light gray, or very pale brown loamy fine sand or fine sand. In the upper 10 inches of some pedons there are no carbonates, and reaction is mildly alkaline. The soil is 0 to 10 percent by volume caliche and siliceous gravel.

## Mobeetie series

The Mobeetie series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy sediment. Slopes range from 1 to about 16 percent.

Typical pedon of Mobeetie fine sandy loam, 5 to 12 percent slopes; from the Hemphill County line, 0.6 mile southwest on U.S. Highway 60, and 40 feet south in rangeland:

A1—0 to 7 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; common very fine roots; many fine and very fine pores; many wormcasts; few caliche pebbles up to 2 inches in diameter; calcareous; moderately alkaline; clear smooth boundary.

B2—7 to 28 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak very coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; common very fine roots; many medium to very fine pores; many wormcasts; few caliche pebbles to 2 inches in diameter; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—28 to 51 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak very coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; many fine and very fine pores; few wormcasts; few caliche pebbles up to 1 inch in diameter; many threads, films, and a few very fine soft masses of calcium carbonate comprising about 5 percent by volume; calcareous; moderately alkaline; diffuse smooth boundary.

C—51 to 80 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; common fine and very fine pores; few caliche pebbles up to 1 inch in diameter; few threads and films of calcium carbonate; calcareous; moderately alkaline.

Solum thickness ranges from 30 to 55 inches. Depth to carbonates is 0 to 10 inches.

The A horizon is brown or grayish brown.

The B2 horizon is brown, pale brown, or light yellowish brown. The B3ca horizon is light brown, reddish yellow, light yellowish brown, or very pale brown. It is 1 to 10 percent by volume carbonates as threads, films, soft masses, and concretions.

The C horizon is very pale brown, light brown, light yellowish brown, or pink. Caliche fragments and siliceous gravel up to 2 inches in diameter are present in some pedons and make up as much as 10 percent of the volume.

## Obaro series

The Obaro series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in loamy, calcareous, reddish sandstone, or siltstone. Slopes range from 5 to 16 percent.

Typical pedon of Obaro loam in an area of Obaro-Quinlan association, rolling; from the Canadian River Bridge, 0.2 mile north on Texas Highway 70, 15 miles west on a county road, about 0.5 mile south on private road, and 200 feet east in rangeland:

A1—0 to 5 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable; common fine roots; few fine pores; common wormcasts; calcareous; moderately alkaline; gradual smooth boundary.

B2—5 to 13 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; few fine pores; few threads, films, and very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—13 to 25 inches; reddish yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; hard, friable; few fine pores; about 3 percent by volume threads, films, soft bodies, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cr—25 to 60 inches; yellowish red (5YR 4/6) weakly cemented siltstone.

The solum ranges from 20 to 40 inches thick.

The A horizon is reddish brown or brown and is loam, silt loam, or silty clay loam.

The B horizon is light reddish brown, reddish brown, reddish yellow, or yellowish red. It is loam, silt loam, or silty clay loam. The calcium carbonate content of the B3ca horizon is 0 to 5 percent by volume in the form of threads and films.

The Cr horizon is weakly cemented sandstone, siltstone, or soft packsand. It is red, reddish brown, yellowish red, or reddish yellow.

## Olton series

The Olton series consists of deep, loamy soils on uplands. These soils formed in calcareous, loamy material, mostly of eolian origin. Slopes range from 0 to 5 percent.

Typical pedon of Olton clay loam, 1 to 3 percent slopes; from the intersection of Farm Roads 1268 and 748 south of Miami, east 4.9 miles to a county road, 3.5 miles north, and 50 feet east in rangeland:

A1—0 to 7 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate very fine subangular blocky structure; very hard, firm; many fine roots; many very fine pores; common wormcasts; neutral; clear smooth boundary.

B21t—7 to 17 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium blocky structure; very hard, very firm; common very fine roots; common very fine pores; few wormcasts; few patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—17 to 32 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; few very fine roots; common very fine pores; few wormcasts; patchy clay films on faces of peds; few threads, films, and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23tca—32 to 48 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, firm; few very fine roots; common very fine pores; few wormcasts; patchy clay films on faces of peds; about 10 percent by volume threads, films, and fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B24tca—48 to 58 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium blocky structure; very hard, firm; many fine and very fine pores; few wormcasts; patchy clay films on faces of peds; about 35 percent by volume threads and films and few very fine soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B25t—58 to 65 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, firm; many fine and very fine pores; few patchy clay films on faces of peds; few threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B26tca—65 to 80 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium blocky structure; very hard, firm; common very fine pores; few patchy clay films on faces of peds; many threads, films, and few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

Solum thickness is 80 to more than 120 inches. Depth to secondary soft carbonates is 14 to 22 inches. Depth to the calcic horizon is 30 to 60 inches. The mollic epipedon is 13 to 20 inches thick.

The A horizon is brown, grayish brown, dark brown, or dark grayish brown and is neutral to moderately alkaline.

The upper part of the Bt horizon is dark brown, brown, or reddish brown clay loam or clay. The Btca horizon is reddish brown, light reddish brown, light brown, reddish yellow, or pink. The lower Btca horizon is light reddish brown, yellowish red, or reddish yellow.

## Paloduro series

The Paloduro series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous loamy sediment. Slopes range from 1 to about 16 percent.

Typical pedon of Paloduro loam, 5 to 8 percent slopes; from the intersection of U.S. Highway 60 and Farm Road 282 in Miami, 6.0 miles west on Farm Road 282 to a county road, 2.1 miles south, and 0.3 mile east in rangeland:

A1—0 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; hard, friable; common fine and very fine roots; many very fine pores; many wormcasts; few caliche fragments up to 1.5 inches in diameter; calcareous; moderately alkaline; clear smooth boundary.

B21—12 to 24 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; hard, friable; common very fine roots; many fine and very fine pores; many wormcasts; few caliche pebbles up to 1 inch in diameter; common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22—24 to 36 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak very fine subangular blocky; hard, friable; few very fine roots; many fine and very fine pores; common wormcasts; few caliche fragments up to 1 inch in diameter; about 5 percent by volume threads, films, and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23—36 to 55 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; many fine and very fine pores; few caliche fragments up to 2 centimeters in diameter; common threads, films, and a few very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—55 to 80 inches; pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; massive; hard, friable; calcareous; moderately alkaline.

Solum thickness is 55 to more than 80 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon is dark grayish brown or brown.

The B2 horizon is reddish brown, brown, grayish brown, light brownish gray, light brown, yellowish brown, pale brown, light yellowish brown, pink, or very pale brown. It is clay loam or sandy clay loam. Calcium carbonates are visible in the B2 horizon as threads, films, and fine concretions that make up 0 to 12 percent of the volume.

Buried layers of varying textures and colors are in some pedons at a depth of 40 to 80 inches. A pinkish calcic horizon is in some pedons below a depth of 40 inches.

## Potter series

The Potter series consists of very shallow, loamy soils on uplands. These soils formed in calcareous, loamy caliche material. Slopes range from 3 to 45 percent.

Typical pedon of Potter loam, 3 to 12 percent slopes; from the intersection of Farm Roads 282 and 283, 10 miles northwest on Farm Road 283, 2.5 miles north on a county road, 1.1 miles northeast on a ranch road, and 500 feet east in rangeland:

A11—0 to 4 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable; common very fine roots; about 15 percent by volume medium to very fine pebbles of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

A12—4 to 9 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; common very fine roots; about 25 percent caliche pebbles up to 2 inches in diameter; calcareous; moderately alkaline; abrupt wavy boundary.

C1ca—9 to 20 inches; pink (7.5YR 7/4) platy caliche; light brown (7.5YR 6/4) moist; plates have a hardness of less than 3 on the Mohs' scale and can be cut with a spade; plates are fractured and have pendants of calcium carbonate up to 0.5 inch thick on their lower sides; between the plates is soft calcium and a few fine and very fine roots; calcareous; moderately alkaline; clear wavy boundary.

C2ca—20 to 60 inches; pink (7.5YR 8/4) caliche fragments and loamy caliche material with intermingled pinkish calcareous earths, light brown (7.5YR 6/4) moist; about 60 percent by volume caliche fragments to 4 inches long that have a hardness of slightly less than 3 on the Mohs' scale; the rest is loamy caliche material and calcareous earths.

Thickness of the solum to the C1ca horizon is 4 to 12 inches.

The A horizon is 0 to 30 percent coarse fragments of hard caliche and siliceous pebbles. It is brown, grayish brown, light brownish gray, or pale brown loam or gravelly loam.

The C1ca horizon is brown, pale brown, very pale brown, or pink. The C2ca horizon ranges from platy caliche having a hardness of slightly less than 3 on the Mohs' scale and having intermingled pockets of pinkish loamy earths to soft beds of caliche and loamy calcareous materials.

## Pullman series

The Pullman series consists of deep, well drained, loamy soils on uplands. These soils formed in loamy calcareous material, probably loess. Slopes range from 0 to 3 percent.

Typical pedon of Pullman clay loam, 0 to 1 percent slopes; from the intersection of Texas Highway 70 and Farm Road 282, 9.2 miles east and north on Farm Road 282, and 200 feet north in cropland:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; neutral; abrupt smooth boundary.

B21t—6 to 14 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium blocky structure; very hard, very firm; many very fine pores; few wormcasts; patchy clay films on faces of peds; shiny faces on peds; neutral; gradual smooth boundary.

B22t—14 to 24 inches; dark brown (7.5YR 4/2) clay, very dark brown (7.5YR 3/2) moist; strong medium blocky structure when dry, massive when wet; very hard, very firm; few very fine pores; patchy clay films on faces of peds; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23t—24 to 36 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; common very fine pores; patchy clay films on faces of peds; calcareous; moderately alkaline; diffuse smooth boundary.

B24t—36 to 50 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, firm; common medium to very fine pores; patchy clay films on faces of peds; common threads, films, and a few very fine soft bodies of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

B25tca—50 to 64 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate fine blocky structure; very hard, firm; common fine and very fine pores; patchy clay films on faces of peds; about 20 percent by volume calcium carbonate as threads, films, soft masses, and concretions; calcareous; moderately alkaline; clear wavy boundary.

B26tca—64 to 78 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium blocky structure; hard, firm; few fine pores; patchy clay films on faces of peds; about 35 percent by volume threads, films, soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.
B27tca—78 to 80 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak medium blocky structure; hard, firm; about 2 percent by volume films, threads, and soft masses of calcium carbonate; patchy clay films on faces of peds; moderately alkaline.

The solum is 60 to more than 80 inches thick. Depth to the calcic horizon is 50 to 60 inches. Secondary soft carbonates are commonly at a depth of 13 to 36 inches.

The A horizon is brown, or dark grayish brown and neutral to moderately alkaline.

The B21t and B22t horizons are brown or dark grayish brown. Clay content is 40 to 55 percent. The B23t, B24t, and B25t horizons are brown, reddish brown, or yellowish red clay, clay loam, or silty clay loam. The Btca horizon is brown, yellowish red, or reddish yellow clay or clay loam. Calcium carbonate in the Btca horizon ranges from 20 to 50 percent, mainly as soft masses and concretions.

## Quinlan series

The Quinlan series consists of shallow, well drained, loamy soils on uplands. These soils formed in loamy, calcareous, reddish sandstone and siltstone. Slopes range from 3 to 16 percent.

Typical pedon of Quinlan loam in an area of Obaro-Quinlan association, rolling; from the Canadian River Bridge, 0.2 mile north on Texas Highway 70, 15 miles west on a county road, 0.6 mile south on ranch road, and 200 feet east in rangeland:

A—0 to 5 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak medium granular structure; slightly hard, friable; common very fine roots; few fine pores; calcareous; moderately alkaline; gradual wavy boundary.
B2—5 to 14 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak fine granular structure; slightly hard, friable; calcareous; moderately alkaline; gradual wavy boundary.
Cr—14 to 60 inches; reddish yellow (5YR 6/6) weakly cemented, calcareous sandstone, yellowish red (5YR 5/6) moist.

Thickness of the solum is 10 to 20 inches.

The A horizon is brown, reddish brown, yellowish red, or light reddish brown loam, silt loam, or silty clay loam.

The B2 horizon is reddish brown, light reddish brown, yellowish red, or reddish yellow loam, silt loam, or silty clay loam.

The Cr horizon is red, reddish brown, yellowish red, or reddish yellow. It is weakly cemented sandstone or siltstone.

## Randall series

The Randall series consists of deep, somewhat poorly drained, clayey soils in the bottoms of intermittent lakes, or playas. These soils formed in clayey local alluvium. Slopes range from 0 to 1 percent.

Typical pedon of Randall clay; from the intersection of Farm Roads 282 and 283 northwest of Miami, 9.4 miles west on Farm Road 282, 1.0 mile south on a county road to another county road, 800 feet west, and 50 feet south in a playa:

A11—0 to 5 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate very fine blocky structure; extremely hard, very firm; common medium to very fine roots; mildly alkaline; clear wavy boundary.
A12—5 to 16 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak coarse angular blocky structure parting to moderate fine blocky dominated by wedge-shaped peds 1 to 3 inches in length with long axes tilted 10 to 30 degrees from horizontal; extremely hard, very firm, very sticky and plastic; many shiny faces on peds; many intersecting slickensides; mildly alkaline; gradual wavy boundary.
AC1—16 to 34 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure; dominated by wedge-shaped peds 1 to 3 inches long with long axis tilted 10 to 30 degrees from horizontal; extremely hard, very firm, very sticky and plastic; many shiny faces on peds; many intersecting slickensides, a few up to 2 feet long; mildly alkaline; diffuse smooth boundary.
AC2—34 to 50 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium and fine angular blocky structure; extremely hard, very firm, very sticky and plastic; many of the peds are wedge-shaped; many short slickensides, a few up to 2 feet long; moderately alkaline; diffuse wavy boundary.
AC3—50 to 80 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak fine blocky structure; extremely hard, very firm, very sticky and plastic; many shiny faces of peds; few short intersecting slickensides; few very fine soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 16 to 40 inches thick. It is very dark gray, or dark gray and mildly alkaline to moderately alkaline. The AC horizon is dark gray, dark grayish brown, grayish brown, or gray.

## Spur series

The Spur series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous loamy alluvium. Slopes range from .5 to 1 percent.

Typical pedon of Spur clay loam, occasionally flooded; from the Canadian River Bridge, 4.0 miles south on Texas Highway 70; 3.4 miles east on Farm Road 283; and 250 feet north in rangeland:

A11—0 to 6 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; few fine pores; calcareous; moderately alkaline; abrupt smooth boundary.

A12—6 to 14 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; common fine roots; few fine pores; common wormcasts; calcareous; moderately alkaline; clear smooth boundary.

B2—14 to 30 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; few strata of slightly darker material .5 to 1.5 inches thick; few fine roots; few fine pores; common wormcasts; few threads and films of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

C1—30 to 38 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; few very fine roots; few very fine pores; few threads and films of calcium carbonate; few thin strata of loam; calcareous; moderately alkaline; abrupt smooth boundary.

C2—38 to 80 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; few very fine roots; few very fine pores; common threads and films of calcium carbonate; few thin strata of clay loam; calcareous; moderately alkaline.

Thickness of the mollic epipedon is 11 to 15 inches.

The A horizon is dark grayish brown or dark brown.

The B horizon is brown, grayish brown, or dark brown clay loam or loam.

The C horizon is light brown, brown, very pale brown, yellowish brown, or light yellowish brown clay loam or loam.

## Sweetwater series

The Sweetwater series consists of deep, poorly drained, loamy soils on bottom lands. These soils formed in loamy alluvium that is about 2 feet thick over sandy alluvium. These soils have a high water table. Slopes range from 0 to about 3 percent.

Typical pedon of Sweetwater silty clay loam; from the Hemphill County line on the north side of the Canadian River Bridge, 4.3 miles west on a county road, 0.6 mile south and 0.3 mile southeast on oilfield roads to oil well, and 90 feet north in rangeland:

A11—0 to 10 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; very hard, firm; common medium to very fine roots; calcareous; moderately alkaline; clear smooth boundary.

A12—10 to 18 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; weak fine subangular blocky structure; very hard, firm; common very fine roots; few very fine prominent dark yellowish brown (10YR 3/4) mottles; calcareous; moderately alkaline; clear smooth boundary.

C1—18 to 24 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; few fine and very fine prominent dark yellowish brown (10YR 3/4) mottles; weak fine subangular blocky structure; very hard, firm; common fine and very fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

C2—24 to 80 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; massive; soft, loose; few faint mottles; calcareous; moderately alkaline.

The solum is 18 to 25 inches thick.

The A horizon is mildly to moderately alkaline. The A11 horizon is dark gray or gray. The A12 horizon is gray, grayish brown, or light brownish gray.

The C horizon is grayish brown, light brownish gray, brown, pale brown, or very pale brown. The C1 horizon is fine sandy loam or sandy clay loam. The lower part of the C horizon is dominantly loamy sand, but have thin strata of loamy and clayey material. Dark buried layers of varying textures are present in some pedons.

## Tascosa series

The Tascosa series consists of deep, well drained, loamy soils on uplands. These soils formed in gravelly and sandy outwash material. Slopes range from 3 to 30 percent.

Typical pedon of Tascosa gravelly fine sandy loam, in an area of Likes-Tascosa association, hilly; from the Canadian River Bridge, 7.0 miles south on Texas Highway 70, and 300 feet west in rangeland:

A1—0 to 7 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; many roots; about 20 percent by volume rounded quartzite pebbles up to 3 inches in diameter; about 20 percent of soil surface is covered with pebbles and a few cobbles; few wormcasts; calcareous; moderately alkaline; clear smooth boundary.

B2ca—7 to 14 inches; brown (7.5YR 5/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; weak fine

subangular blocky structure; slightly hard, very friable; common roots; films, threads, and thin coatings of calcium carbonate on lower sides of quartzite pebbles make up about 5 percent by volume; rounded quartzite pebbles up to 3 inches in diameter make up about 40 percent by volume; calcareous; moderately alkaline; clear smooth boundary.

Cca—14 to 24 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few roots; about 25 percent of calcium carbonate is soft bodies and coatings on pebbles; rounded quartzite pebbles up to 3 inches in diameter make up 40 percent of the volume; calcareous; moderately alkaline; gradual smooth boundary.

C—24 to 50 inches; pink (7.5YR 7/4) gravelly sandy loam, light brown (7.5YR 6/4) moist; single grained; loose, very friable; quartzite pebbles make up about 20 percent; finely divided calcium carbonates make up 10 percent; calcareous; moderately alkaline.

The solum to the Cca horizon ranges from 12 to 22 inches thick.

The A horizon is grayish brown, brown, or dark grayish brown. It is gravelly fine sandy loam or gravelly sandy loam. Content of quartzite pebbles is 20 to 40 percent.

The B2ca horizon is brown or light brown. It is very gravelly fine sandy loam, very gravelly sandy loam, or gravelly fine sandy loam. Content of quartzite pebbles is 40 to 55 percent, and 5 to 30 percent is soft masses, films, and threads of calcium carbonate.

The Cca horizon is pale brown, light brown, or pink. It is very gravelly sandy loam or gravelly loamy sand. Content of quartzite pebbles is 25 to 50 percent with 5 to 40 percent soft masses and concretions of calcium carbonate. The C horizon is pink or very pale brown. It is gravelly loamy sand or gravelly sandy loam. Content of quartzite pebbles is 15 to 30 percent with about 2 to 10 percent soft masses, concretions, films, and threads of calcium carbonate.

In Roberts County, Tascosa soils are considered taxadjuncts to the Tascaso series because they have a lower gravel content throughout. The weighted average of the control section is 25 to 30 percent gravel. However, there is no difference in use or management.

## Texroy series

The Texroy series consists of deep, well drained, loamy soils on uplands. These soils formed in loamy, calcareous material. Slopes range from 0 to 3 percent.

Typical pedon of Texroy loam, 0 to 1 percent slopes; from the Gray County line, 1.2 miles north on Farm Road 282 to a county road, 16.1 miles north, and 75 feet west in rangeland:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; hard, very friable; many fine and very fine roots; many wormcasts; neutral; clear smooth boundary.

B21t—8 to 16 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very coarse prismatic structure parting to moderate fine subangular blocky; very hard, friable; many very fine roots; many very fine pores; many wormcasts; few patchy clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—16 to 24 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; many very fine roots; many fine and very fine pores; many wormcasts; few patchy clay films on faces of peds; moderately alkaline; gradual smooth boundary.

B23t—24 to 42 inches; brown (7.5YR 5/3) loam, brown (7.5YR 4/3) moist; moderate very coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; common very fine roots; common fine and very fine pores; common wormcasts; few patchy clay films on faces of peds; common threads and films of calcium carbonate on peds and in pores; calcareous; moderately alkaline; gradual smooth boundary.

B24t—42 to 52 inches; brown (7.5YR 5/3) loam, brown (7.5YR 4/3) moist; moderate very coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; few very fine roots; common fine and very fine pores; few patchy clay films on faces of peds; few threads and films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B25tca—52 to 65 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate coarse prismatic parting structure to weak fine subangular blocky; very hard, friable; common fine and very fine pores; few patchy clay films on faces of peds; many threads and films of calcium carbonate on peds and in pores; few very fine soft masses and concretions of calcium carbonate that make up about 5 percent of volume; calcareous; moderately alkaline; gradual smooth boundary.

B3—65 to 80 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak very coarse prismatic structure; hard, very friable; common fine and very fine pores; few threads and films of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

The solum ranges from 65 to more than 80 inches thick.

The A horizon is dark grayish brown or grayish brown. It is loam, silt loam, or clay loam and is neutral or mildly alkaline.

The B1 horizon, when present, is dark grayish brown or brown. It is loam or clay loam and mildly alkaline or

moderately alkaline. The Bt horizon is a brown, dark brown, dark grayish brown, or light brown clay loam or sandy clay loam that is mildly or moderately alkaline. The B3 horizon is brown or light brown and is mildly alkaline or moderately alkaline. In some pedons, buried horizons occur below a depth of 40 inches. They are fine sandy loam, clay loam, silty clay loam, or loamy fine sand.

## Tivoli series

The Tivoli series consists of deep, sandy soils on uplands. These soils formed in sandy, eolian material. Slopes range from about 3 to 30 percent.

Typical pedon of Tivoli fine sand; from the intersection of Texas Highway 70 and Farm Road 283, 1.6 miles north, and 50 feet west in rangeland:

A1—0 to 7 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; weak fine granular structure; loose when dry and moist; common fine and very fine roots; neutral; clear wavy boundary.

C1—7 to 16 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grained; loose when dry and moist; common very fine roots; mildly alkaline; gradual smooth boundary.

C2—16 to 80 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grained; loose when dry and when moist; few very fine roots to a depth of 40 inches; mildly alkaline.

The A horizon is light brown or brown, and slightly acid to mildly alkaline.

The C horizon is light brown, reddish yellow, or pink. It is slightly acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. Some pedons are calcareous below a depth of 40 inches.

## Veal series

The Veal series consists of deep, well drained, loamy soils on uplands. These soils formed in calcareous loamy sediment. Slopes range from 1 to about 16 percent.

Typical pedon of Veal loam, 1 to 5 percent slopes; from the intersection of Texas Highway 70 and Farm Road 282, 11.9 miles north on Texas Highway 70 to a private road, 1.2 miles north, and 50 feet east in rangeland:

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard, very friable; common very fine roots; many wormcasts; few very fine caliche pebbles; calcareous; moderately alkaline; clear smooth boundary.

B21—6 to 18 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate very fine subangular blocky structure; hard, friable; common very fine roots; many wormcasts; common threads and films of calcium carbonate; few very fine caliche pebbles; calcareous; moderately alkaline; abrupt smooth boundary.

B22ca—18 to 35 inches; white (10YR 8/2) clay loam, light gray (10YR 7/2) moist; weak fine subangular blocky structure; hard, friable; few very fine roots; few wormcasts; about 60 percent by volume threads, films, and medium to very fine soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23ca—35 to 64 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; hard, friable; common very fine pores; threads, films, and medium to very fine soft bodies and concretions of calcium carbonate make up about 40 percent by volume; calcareous; moderately alkaline; gradual smooth boundary.

C—64 to 80 inches, light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; few very fine pores; few threads and films of calcium carbonate; calcareous; moderately alkaline.

Depth to the calcic horizon is 17 to 24 inches.

The A horizon is grayish brown or brown.

The B21 horizon is a brown, pale brown, light brown, or light yellowish brown sandy clay loam or clay loam. The B2ca is white, very pale brown, or pink sandy loam or clay loam.

The C horizon, where present, is light yellowish brown or very pale brown sandy clay loam or clay loam.

# formation of the soils

Soil is a natural, three-dimensional body on the earth's surface. It supports plants and has properties that result from the integrated effect of climate and living matter acting on earthy parent material, as conditioned in time by relief.

There are many different soils, but each soil is the result of the interaction of five major factors. These factors are the physical and chemical composition of the parent material, the effect of the climate during and after the accumulation of the parent material, the kind of plants and organisms living in the soil, the relief of the land and its effect on runoff, and the length of time it took the soil to form.

The effect of one or more of these factors can differ from place to place, but it is the interaction of all the factors that determines the kind of soil that forms. In the following paragraphs the factors of soil formation are discussed as they relate to the soils in the survey area.

## parent material

Parent material is the unconsolidated mass from which a soil is formed. It determines the chemical and mineral composition of the soil. The soils of Roberts County formed in residual, outwash, eolian, and alluvial materials.

The oldest exposed geological formation in the county is the Permian red beds of the Paleozoic era in a few places along the Canadian River. The Obaro and Quinlan soils formed in the weakly consolidated, calcareous earths in these areas.

From the uplift that formed the Rocky Mountains, eastward flowing streams cut into the Permian red beds. These streams deposited large quantities of gravelly and sandy alluvial outwash. Deposition of finer textured sediment followed, and the valley streams were completely backfilled. These deposits, which are several hundred feet thick in places, make up the Ogallala Formation (*6*). This formation is exposed throughout the county. Major soils that formed in this formation are the Amarillo, Acuff, Berda, Mobeetie, Paloduro, Potter, and Veal soils. Some areas of the sandy outwash material near the Canadian River have been reworked by wind and water into an undulating and hummocky landscape where Tivoli and Likes soils formed.

The saturated sand and gravel at the base of the Ogallala Formation is a source of underground water for agriculture, municipal, and industrial uses. The water probably accumulated during deposition of the formation, and the almost impervious underlying red beds kept it from percolating deeper. At present, there is little recharge of this aquifer from rainfall, and water is being pumped out faster than it is replaced.

During the middle to late part of the Pleistocene Epoch of the Quaternary Period a deposition of eolian sediments covered the Ogallala Formation to form a vast, nearly level, featureless plain called the Llano Estacado. These sediments range from a few feet to more than 100 feet in thickness. Pullman, Olton, Darouzett, and Estacado soils formed in these calcareous sediments. The Ogallala Formation and the overlying eolian sediments are locally known as the "High Plains sediments."

Playas, which are shallow intermittent lakes, receive most of the runoff water on the Llano Estacado because a dendritic, branching, drainage system has not had time to form. Randall clay is the major soil in the playas.

The most recent geological formation in the county is the alluvial deposits along the flood plains of the Canadian River and other major streams. Bippus, Guadalupe, Lincoln, Spur, and Sweetwater soils formed in these sandy and loamy sediments.

## climate

Roberts County is in a cool, temperate climate zone. The climate is dry with mild winters.

This climate contributes to the formation of soils in several ways. In winter, precipitation is mostly in the form of rain, freezing rain, sleet, or snow. This causes low soil temperatures and a reduction of animal activity and plant growth. In warm seasons, rainfall is mostly in the form of thundershowers. During wet periods much of the rain is in downpours, and runoff is rapid. This retards soil development because little of the rain percolates down in to the soil and erosion is severe on unprotected soil surfaces. Summers are hot with little rainfall, which limits the accumulation of organic matter in the soil.

There is enough rainfall, however, to leach the calcium carbonate from the upper horizons of some soils. Most of the soils in the county have films, threads, or soft masses of calcium carbonate in the lower part of their profiles; some have them throughout. Some soils, such as Amarillo, Acuff, and Pullman soils, have an accumulation of clay in their subsoil. Water moving through the soil carries clay particles downward from the

surface layer and deposits them where the water movement slows. Where the clay accumulates, water movement becomes even slower and deposition of clay accelerates. Thus, the process tends to speed up and eventually the lower layers become more and more clayey.

## living organisms

Plants and animals are important in the formation of soils. Living organisms cause gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in soil structure and porosity.

Vegetation, dominantly grasses, has affected soil formation in Roberts County more than other living organisms. Grass roots reach deep into the soil for nutrients. Lime, minerals, and organic matter are distributed throughout the soil as these plants die and decompose. Decomposed plant roots leave channels that increase the intake of water and the aeration of the soil. Earthworms and other soil organisms feed on the decomposed roots. The borings of earthworms also help channel water and air through the soil.

Human civilization has also influenced soil formation, particularly in the way cattle are grazed, crops are planted, and the land is used. The overall effect has been a lowering of the organic matter content of the surface layer and removal of parts of the surface layer by accelerated erosion.

## relief

Gradient and shape of slope are characteristics that affect soil development because they control drainage and runoff. If all other factors are equal, profile development depends to a great degree on the amount of water that enters the soil.

Steep and sloping soils absorb less moisture than the nearly level and gently sloping soils, therefore, they generally have less profile development. Potter and Berda soils are examples of soils that have little profile development.

Soils that formed in depressions, such as Randall soils, receive runoff water from adjoining slopes and remain wet for long periods. As a result, they have grayish colors from poor drainage.

Nearly level to slightly concave soils are likely to be darker than sloping soils. They receive more moisture, produce more vegetation, and consequently contain more organic matter, which imparts the darker color. The Bippus and Spur soils are examples of these darker soils.

## time

Generally, a long time is required for the formation of a soil with distinct layers, or horizons. The length of time that the parent material has been in place is commonly reflected by the degree of development of the soil profile. Nearly level to gently sloping soils that have been in place for long periods of time, such as the Pullman and Acuff soils, generally show the greatest profile development.

Young soils in Roberts County formed in recent alluvium. Lincoln, Guadalupe, and Spur soils are examples of young soils with little profile development.

Many sloping and steep, shallow and very shallow soils have been in the process of development for probably about as long as some of the well-developed, nearly level soils. Geologic erosion, however, has removed the soil as fast as it formed. In this case the effect of time is offset by relief. Potter and Quinlan soils are examples of these soils.

# references

(1) American Association of State Highway (and Transportation) Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

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# glossary

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

| | *Inches* |
|---|---|
| Very low | 0 to 3 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | 9 to 12 |
| Very high | More than 12 |

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Climax vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Complex slope.** Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing

crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

**Deferred grazing.** Postponing grazing or arresting grazing for a prescribed period.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Excess lime** (in tables). Excess carbonates in the soil that restrict the growth of some plants.

**Fallow.** Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is

common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

**Fast intake** (in tables). The rapid movement of water into the soil.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fine textured soil.** Sandy clay, silty clay, and clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forb.** Any herbaceous plant not a grass or a sedge.

**Fragile** (in tables). A soil that is easily damaged by use or disturbance.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Gilgai.** Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Increasers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as

contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

| | |
|---|---|
| Less than 0.2 | very low |
| 0.2 to 0.4 | low |
| 0.4 to 0.75 | moderately low |
| 0.75 to 1.25 | moderate |
| 1.25 to 1.75 | moderately high |
| 1.75 to 2.5 | high |
| More than 2.5 | very high |

**Invaders.** On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Moderately coarse textured soil.** Sandy loam and fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, and silty clay loam.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Outwash plain.** A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

**Pan.** A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from

about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

| | |
|---|---|
| Very slow | less than 0.06 inch |
| Slow | 0.06 to 0.20 inch |
| Moderately slow | 0.2 to 0.6 inch |
| Moderate | 0.6 inch to 2.0 inches |
| Moderately rapid | 2.0 to 6.0 inches |
| Rapid | 6.0 to 20 inches |
| Very rapid | more than 20 inches |

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Playa.** A nearly level area at the bottom of a desert basin, sometimes covered with water.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range condition.** The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

**Range site.** An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

| | *pH* |
|---|---|
| Extremely acid | Below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Medium acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Mildly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slow intake** (in tables). The slow movement of water into the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

| | *Millimeters* |
|---|---|
| Very coarse sand | 2.0 to 1.0 |
| Coarse sand | 1.0 to 0.5 |
| Medium sand | 0.5 to 0.25 |
| Fine sand | 0.25 to 0.10 |
| Very fine sand | 0.10 to 0.05 |
| Silt | 0.05 to 0.002 |
| Clay | less than 0.002 |

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Subsurface layer.** Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

**Summer fallow.** The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Valley fill.** In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

# tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-75 at Miami, Texas]

| Month | Temperature | | | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average daily | 2 years in 10 will have-- Maximum temperature higher than-- | 2 years in 10 will have-- Minimum temperature lower than-- | Average number of growing degree days[1] | Average | 2 years in 10 will have-- Less than-- | 2 years in 10 will have-- More than-- | Average number of days with 0.10 inch or more | Average snowfall |
| | °F | °F | °F | °F | °F | | In | In | In | | In |
| January | 49.6 | 19.9 | 34.8 | 78 | -4 | 6 | .42 | .07 | .70 | 1 | 3.0 |
| February | 53.1 | 23.7 | 38.4 | 83 | 2 | 15 | .86 | .21 | 1.36 | 2 | 5.1 |
| March | 60.1 | 30.3 | 45.2 | 89 | 8 | 95 | 1.02 | .04 | 1.69 | 2 | 2.1 |
| April | 71.7 | 41.8 | 56.8 | 94 | 22 | 232 | 1.56 | .47 | 2.42 | 3 | .7 |
| May | 80.2 | 52.3 | 66.3 | 99 | 32 | 505 | 3.26 | .95 | 5.12 | 5 | .0 |
| June | 88.7 | 61.6 | 75.2 | 103 | 46 | 756 | 2.90 | 1.17 | 4.29 | 5 | .0 |
| July | 93.6 | 66.4 | 80.0 | 106 | 53 | 930 | 2.79 | 1.08 | 4.16 | 5 | .0 |
| August | 92.5 | 64.6 | 78.6 | 105 | 52 | 887 | 2.49 | 1.20 | 3.53 | 4 | .0 |
| September | 84.3 | 55.9 | 70.1 | 102 | 37 | 603 | 2.20 | .66 | 3.42 | 4 | .0 |
| October | 74.1 | 43.8 | 58.9 | 94 | 26 | 288 | 1.65 | .45 | 2.63 | 3 | .0 |
| November | 59.9 | 30.7 | 45.4 | 83 | 11 | 52 | .89 | .02 | 1.52 | 2 | 1.5 |
| December | 51.6 | 23.0 | 37.4 | 78 | 2 | 6 | .62 | .06 | 1.02 | 2 | 2.2 |
| Yearly: | | | | | | | | | | | |
| Average | 71.6 | 42.8 | 57.3 | --- | --- | --- | --- | --- | --- | --- | --- |
| Extreme | --- | --- | --- | 107 | -5 | --- | --- | --- | --- | --- | --- |
| Total | --- | --- | --- | --- | --- | 4,375 | 20.66 | 15.48 | 25.46 | 38 | 14.6 |

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Based on data recorded in the period 1951-75 at Miami, Texas]

| Probability | Temperature | | |
|---|---|---|---|
| | 24° F or lower | 28° F or lower | 32° F or lower |
| Last freezing temperature in spring: | | | |
| 1 year in 10 later than-- | April 11 | April 25 | May 6 |
| 2 years in 10 later than-- | April 6 | April 19 | May 1 |
| 5 years in 10 later than-- | March 28 | April 9 | April 20 |
| First freezing temperature in fall: | | | |
| 1 year in 10 earlier than-- | October 28 | October 18 | October 8 |
| 2 years in 10 earlier than-- | November 1 | October 23 | October 14 |
| 5 years in 10 earlier than-- | November 9 | November 3 | October 24 |

TABLE 3.--GROWING SEASON LENGTH

[Based on data recorded in the period 1951-75 at Miami, Texas]

| Probability | Daily minimum temperature | | |
|---|---|---|---|
| | Higher than 24° F | Higher than 28° F | Higher than 32° F |
| | Days | Days | Days |
| 9 years in 10 | 207 | 184 | 164 |
| 8 years in 10 | 213 | 191 | 172 |
| 5 years in 10 | 225 | 206 | 186 |
| 2 years in 10 | 238 | 221 | 200 |
| 1 year in 10 | 244 | 229 | 208 |

TABLE 4.--LAND USE SUITABILITIES AND LIMITATIONS OF GENERAL SOIL MAP UNITS

| Map unit | Extent of area | Cultivated crops | Rangeland | Urban uses | Recreation areas |
|---|---|---|---|---|---|
| | Pct | | | | |
| 1. Mobeetie-Potter-Berda | 41 | Poor: slope, erodes easily, depth to rock. | Moderately well: slopes, depth to rock. | Moderately well: slope, depth to rock. | Poor: slope, depth to rock. |
| 2. Estacado-Paloduro | 23 | Poor: slope, erodes easily. | Well---------- | Moderately well: slope. | Moderately well: slope. |
| 3. Likes-Lincoln-Tivoli | 21 | Poor: wind erosion, low available water capacity, low fertility. | Well---------- | Moderately well: too sandy, cutbanks cave, floods. | Moderately well: too sandy, floods. |
| 4. Pullman-Darrouzett-Olton | 9 | Moderately well: droughty. | Moderately well: droughty. | Moderately well: shrink-swell, too clayey. | Moderately well: percs slowly. |
| 5. Amarillo-Acuff-Veal | 6 | Moderately well: slope, wind erosion. | Well---------- | Well---------- | Well. |

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

| Map symbol | Soil name | Acres | Percent |
|---|---|---|---|
| 1 | Acuff loam, 1 to 3 percent slopes | 6,520 | 1.1 |
| 2 | Acuff loam, 3 to 5 percent slopes | 2,810 | 0.5 |
| 3 | Amarillo fine sandy loam, 0 to 1 percent slopes | 2,340 | 0.4 |
| 4 | Amarillo fine sandy loam, 1 to 3 percent slopes | 6,510 | 1.1 |
| 5 | Amarillo fine sandy loam, 3 to 5 percent slopes | 4,400 | 0.8 |
| 6 | Berda-Potter association, steep | 69,850 | 11.9 |
| 7 | Bippus fine sandy loam, 1 to 3 percent slopes | 2,190 | 0.4 |
| 8 | Bippus clay loam, 0 to 1 percent slopes | 2,460 | 0.4 |
| 9 | Bippus clay loam, 1 to 3 percent slopes | 4,640 | 0.8 |
| 10 | Darrouzett silty clay loam, 0 to 1 percent slopes | 10,580 | 1.8 |
| 11 | Devol loamy fine sand, 3 to 8 percent slopes | 4,660 | 0.8 |
| 12 | Estacado clay loam, 0 to 1 percent slopes | 760 | 0.1 |
| 13 | Estacado clay loam, 1 to 3 percent slopes | 12,650 | 2.2 |
| 14 | Estacado clay loam, 3 to 5 percent slopes | 30,490 | 5.2 |
| 15 | Estacado-Paloduro association, rolling | 33,050 | 5.6 |
| 16 | Guadalupe fine sandy loam, occasionally flooded | 8,520 | 1.5 |
| 17 | Likes loamy fine sand, 1 to 8 percent slopes | 39,500 | 6.7 |
| 18 | Likes-Tascosa association, hilly | 17,640 | 3.0 |
| 19 | Lincoln fine sand, frequently flooded | 28,860 | 4.9 |
| 20 | Mobeetie fine sandy loam, 1 to 3 percent slopes | 3,990 | 0.7 |
| 21 | Mobeetie fine sandy loam, 3 to 5 percent slopes | 3,060 | 0.5 |
| 22 | Mobeetie fine sandy loam, 5 to 12 percent slopes | 27,790 | 4.7 |
| 23 | Mobeetie-Veal-Potter association, rolling | 102,960 | 17.5 |
| 24 | Obaro-Quinlan association, rolling | 450 | 0.1 |
| 25 | Olton clay loam, 0 to 1 percent slopes | 3,500 | 0.5 |
| 26 | Olton clay loam, 1 to 3 percent slopes | 5,780 | 1.0 |
| 27 | Olton clay loam, 3 to 5 percent slopes | 1,160 | 0.2 |
| 28 | Paloduro loam, 3 to 5 percent slopes | 4,820 | 0.8 |
| 29 | Paloduro loam, 5 to 8 percent slopes | 5,440 | 0.9 |
| 30 | Paloduro-Estacado-Potter association, rolling | 63,970 | 10.9 |
| 31 | Potter loam, 3 to 12 percent slopes | 13,580 | 2.3 |
| 32 | Pullman clay loam, 0 to 1 percent slopes | 23,200 | 3.9 |
| 33 | Pullman clay loam, 1 to 3 percent slopes | 1,890 | 0.3 |
| 34 | Randall clay | 1,690 | 0.3 |
| 35 | Spur clay loam, occasionally flooded | 3,400 | 0.6 |
| 36 | Sweetwater silty clay loam | 4,180 | 0.7 |
| 37 | Texroy loam, 0 to 1 percent slopes | 1,920 | 0.3 |
| 38 | Texroy loam, 1 to 3 percent slopes | 1,190 | 0.2 |
| 39 | Tivoli fine sand | 19,130 | 3.2 |
| 40 | Veal loam, 1 to 5 percent slopes | 1,830 | 0.3 |
| | Water | 5,440 | 0.9 |
| | Total | 588,800 | 100.0 |

TABLE 6.--YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

| Map symbol and soil name | Grain sorghum | | Wheat | | Alfalfa hay | |
|---|---|---|---|---|---|---|
| | N | I | N | I | N | I |
| | Bu | Bu | Bu | Bu | Ton | Ton |
| 1---------- Acuff | 20 | 100 | 16 | 45 | --- | 6.0 |
| 2---------- Acuff | 15 | 80 | 14 | 40 | --- | --- |
| 3---------- Amarillo | 25 | 120 | 15 | 50 | --- | --- |
| 4---------- Amarillo | 20 | 100 | 12 | 45 | --- | --- |
| 5---------- Amarillo | 15 | 75 | 10 | 40 | --- | --- |
| 6:* | | | | | | |
| Berda---------- | --- | --- | --- | --- | --- | --- |
| Potter---------- | --- | --- | --- | --- | --- | --- |
| 7---------- Bippus | 20 | 100 | 15 | 45 | --- | 6.0 |
| 8---------- Bippus | 25 | 110 | 18 | 60 | --- | 6.0 |
| 9---------- Bippus | 20 | 100 | 16 | 50 | --- | 6.0 |
| 10---------- Darrouzett | 25 | 130 | 18 | 60 | --- | 5.5 |
| 11---------- Devol | 25 | --- | 15 | --- | --- | --- |
| 12---------- Estacado | 25 | 100 | 18 | 45 | --- | 5.5 |
| 13---------- Estacado | 20 | 90 | 15 | 40 | --- | 5.0 |
| 14---------- Estacado | 15 | 70 | 12 | 35 | --- | --- |
| 15:* | | | | | | |
| Estacado---------- | --- | --- | --- | --- | --- | --- |
| Paloduro---------- | --- | --- | --- | --- | --- | --- |

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

| Map symbol and soil name | Grain sorghum | | Wheat | | Alfalfa hay | |
|---|---|---|---|---|---|---|
| | N | I | N | I | N | I |
| | Bu | Bu | Bu | Bu | Ton | Ton |
| 16--- Guadalupe | 35 | 100 | 25 | 45 | --- | 6.0 |
| 17--- Likes | --- | --- | --- | --- | --- | --- |
| 18:* | | | | | | |
| Likes--- | --- | --- | --- | --- | --- | --- |
| Tascosa--- | --- | --- | --- | --- | --- | --- |
| 19--- Lincoln | --- | --- | --- | --- | --- | --- |
| 20--- Mobeetie | 15 | 60 | 12 | 35 | --- | 4.0 |
| 21--- Mobeetie | 12 | 50 | 10 | 30 | --- | --- |
| 22--- Mobeetie | --- | --- | --- | --- | --- | --- |
| 23:* | | | | | | |
| Mobeetie--- | --- | --- | --- | --- | --- | --- |
| Veal--- | --- | --- | --- | --- | --- | --- |
| Potter--- | --- | --- | --- | --- | --- | --- |
| 24:* | | | | | | |
| Obaro--- | --- | --- | --- | --- | --- | --- |
| Quinlan--- | --- | --- | --- | --- | --- | --- |
| 25--- Olton | 20 | 115 | 16 | 60 | --- | 5.5 |
| 26--- Olton | 15 | 100 | 14 | 50 | --- | 5.0 |
| 27--- Olton | 12 | 80 | 10 | 35 | --- | --- |
| 28--- Paloduro | 12 | 70 | 10 | 35 | --- | --- |
| 29--- Paloduro | --- | --- | --- | --- | --- | --- |
| 30:* | | | | | | |
| Paloduro--- | --- | --- | --- | --- | --- | --- |
| Estacado--- | --- | --- | --- | --- | --- | --- |
| Potter--- | --- | --- | --- | --- | --- | --- |

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS--Continued

| Map symbol and soil name | Grain sorghum | | Wheat | | Alfalfa hay | |
|---|---|---|---|---|---|---|
| | N | I | N | I | N | I |
| | Bu | Bu | Bu | Bu | Ton | Ton |
| 31--Potter | --- | --- | --- | --- | --- | --- |
| 32--Pullman | 20 | 125 | 15 | 60 | --- | 5.5 |
| 33--Pullman | 15 | 100 | 12 | 50 | --- | 5.0 |
| 34--Randall | --- | --- | --- | --- | --- | --- |
| 35--Spur | 25 | 110 | 20 | 60 | --- | 6.0 |
| 36--Sweetwater | --- | --- | --- | --- | --- | --- |
| 37--Texroy | 30 | 120 | 25 | 60 | 2.5 | 6.0 |
| 38--Texroy | 25 | 100 | 20 | 55 | 2.0 | 6.0 |
| 39--Tivoli | --- | --- | --- | --- | --- | --- |
| 40--Veal | 14 | 40 | 10 | 25 | --- | --- |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

| Class | Total acreage | Major management concerns (Subclass) | | | |
|---|---|---|---|---|---|
| | | Erosion (e) | Wetness (w) | Soil problem (s) | Climate (c) |
| | | Acres | Acres | Acres | Acres |
| I (N) | --- | --- | --- | --- | --- |
| (I) | 1,920 | --- | --- | --- | --- |
| II (N) | 22,130 | 7,750 | 14,380 | --- | --- |
| (I) | 62,780 | 25,200 | 14,380 | 23,200 | --- |
| III (N) | 79,910 | 79,910 | --- | --- | --- |
| (I) | 37,340 | 37,340 | --- | --- | --- |
| IV (N) | 53,230 | 53,230 | --- | --- | --- |
| (I) | 48,570 | 48,570 | --- | --- | --- |
| V (N) | 33,040 | --- | 33,040 | --- | --- |
| VI (N) | 294,280 | 288,990 | 1,690 | 5,290 | --- |
| VII (N) | 104,810 | 43,580 | --- | 61,230 | --- |
| VIII (N) | --- | --- | --- | --- | --- |

TABLE 8.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

| Map symbol and soil name | Range site | Potential annual production for kind of growing season | | |
|---|---|---|---|---|
| | | Favorable | Average | Unfavorable |
| | | Lb/acre | Lb/acre | Lb/acre |
| 1, 2---------- Acuff | Clay Loam---------- | 2,100 | 1,600 | 1,200 |
| 3, 4, 5---------- Amarillo | Sandy Loam---------- | 2,800 | 2,100 | 1,400 |
| 6:* | | | | |
| Berda---------- | Rough Breaks---------- | 1,400 | 800 | 400 |
| Potter---------- | Very Shallow---------- | 900 | 700 | 400 |
| 7, 8, 9---------- Bippus | Draw---------- | 3,000 | 2,400 | 1,800 |
| 10---------- Darrouzett | Clay Loam---------- | 2,200 | 1,800 | 1,400 |
| 11---------- Devol | Loamy Sand---------- | 3,700 | 2,600 | 1,900 |
| 12, 13, 14---------- Estacado | Loamy---------- | 2,200 | 1,700 | 1,300 |
| 15:* | | | | |
| Estacado---------- | Loamy---------- | 2,200 | 1,700 | 1,300 |
| Paloduro---------- | Hardland Slopes---------- | 2,800 | 2,000 | 1,200 |
| 16---------- Guadalupe | Sandy Bottomland---------- | 4,000 | 3,000 | 2,000 |
| 17---------- Likes | Loamy Sand---------- | 3,000 | 2,100 | 1,300 |
| 18:* | | | | |
| Likes---------- | Loamy Sand---------- | 3,000 | 2,100 | 1,300 |
| Tascosa---------- | Gravelly---------- | 1,800 | 1,500 | 1,000 |
| 19---------- Lincoln | Sandy Bottomland---------- | 3,400 | 2,600 | 2,100 |
| 20, 21, 22---------- Mobeetie | Mixedland Slopes---------- | 3,000 | 2,250 | 1,500 |
| 23:* | | | | |
| Mobeetie---------- | Mixedland Slopes---------- | 3,000 | 2,250 | 1,500 |
| Veal---------- | Loamy---------- | 2,800 | 2,100 | 1,400 |
| Potter---------- | Very Shallow---------- | 900 | 700 | 400 |
| 24:* | | | | |
| Obaro---------- | Loamy Prairie---------- | 2,400 | 1,800 | 1,200 |
| Quinlan---------- | Loamy Prairie---------- | 2,500 | 1,800 | 1,300 |
| 25, 26, 27---------- Olton | Clay Loam---------- | 2,100 | 1,600 | 1,200 |
| 28, 29---------- Paloduro | Hardland Slopes---------- | 2,800 | 2,000 | 1,200 |
| 30:* | | | | |
| Paloduro---------- | Hardland Slopes---------- | 2,800 | 2,000 | 1,200 |

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY--Continued

| Map symbol and soil name | Range site | Potential annual production for kind of growing season | | |
|---|---|---|---|---|
| | | Favorable | Average | Unfavorable |
| | | Lb/acre | Lb/acre | Lb/acre |
| 30:* | | | | |
| Estacado | Loamy | 2,200 | 1,700 | 1,300 |
| Potter | Very Shallow | 900 | 700 | 400 |
| 31 | Very Shallow | 900 | 700 | 400 |
| Potter | | | | |
| 32, 33 | Clay Loam | 2,000 | 1,500 | 1,000 |
| Pullman | | | | |
| 34 | Lakebed | 3,000 | 1,200 | 500 |
| Randall | | | | |
| 35 | Draw | 3,000 | 2,400 | 1,800 |
| Spur | | | | |
| 36 | Wet Bottomland | 5,000 | 4,250 | 3,500 |
| Sweetwater | | | | |
| 37, 38 | Clay Loam | 3,000 | 2,500 | 1,800 |
| Texroy | | | | |
| 39 | Sand Hills | 2,000 | 1,400 | 1,000 |
| Tivoli | | | | |
| 40 | Loamy | 2,200 | 1,800 | 1,400 |
| Veal | | | | |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

| Map symbol and soil name | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| 1, 2----------<br>Acuff | --- | Green ash, osageorange, Russian-olive, Arizona cypress, Rocky Mountain juniper, Eastern red cedar. | Honeylocust, oriental arborvitae. | Siberian elm------ | --- |
| 3, 4, 5----------<br>Amarillo | --- | Russian-olive, eastern redcedar, Rocky Mountain juniper. | Green ash, osageorange, oriental arborvitae, Arizona cypress. | Siberian elm, honeylocust. | --- |
| 6:*<br>Berda---------- | --- | Osageorange, eastern redcedar, oriental arborvitae. | --- | Siberian elm------ | --- |
| Potter. | | | | | |
| 7, 8, 9----------<br>Bippus | --- | Russian-olive, eastern redcedar, Rocky Mountain juniper. | Green ash, osageorange, oriental arborvitae, Arizona cypress. | Siberian elm, honeylocust. | --- |
| 10----------<br>Darrouzett | --- | Green ash, osageorange, Russian-olive, eastern redcedar, Arizona cypress. | Honeylocust, oriental arborvitae. | Siberian elm------ | --- |
| 11----------<br>Devol | --- | --- | Austrian pine, ponderosa pine, red mulberry, eastern redcedar. | --- | Eastern cottonwood. |
| 12, 13, 14--------<br>Estacado | --- | Osageorange, eastern redcedar, oriental arborvitae, Rocky Mountain juniper. | --- | Siberian elm------ | --- |
| 15:*<br>Estacado--------- | --- | Osageorange, eastern redcedar, oriental arborvitae, Rocky Mountain juniper. | --- | Siberian elm------ | --- |
| Paloduro--------- | --- | Osageorange, eastern redcedar, oriental arborvitae. | Honeylocust, Arizona cypress. | Siberian elm------ | --- |
| 16.<br>Guadalupe | | | | | |
| 17----------<br>Likes | --- | Russian-olive, eastern redcedar. | Green ash, osageorange, oriental arborvitae, Arizona cypress. | Siberian elm, honeylocust. | --- |

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Map symbol and soil name | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| 18:* | | | | | |
| Likes | --- | Russian-olive, eastern redcedar. | Green ash, osageorange, oriental arborvitae, Arizona cypress. | Siberian elm, honeylocust. | --- |
| Tascosa. | | | | | |
| 19--- Lincoln | --- | American plum, autumn-olive. | Eastern redcedar, red mulberry, osayeorange. | Chinese elm, black locust. | Eastern cottonwood, Scotch pine. |
| 20, 21, 22--- Mobeetie | --- | Eastern redcedar, Russian-olive, osageorange. | Arizona cypress, oriental arborvitae, green ash, honeylocust. | Siberian elm------ | --- |
| 23:* | | | | | |
| Mobeetie | --- | Eastern redcedar, Russian-olive, osageorange. | Arizona cypress, oriental arborvitae, green ash, honeylocust. | Siberian elm------ | --- |
| Veal | --- | Oriental arborvitae, Rocky Mountain juniper, Russian-olive, osageorange, eastern redcedar. | Honeylocust, Siberian elm. | --- | --- |
| Potter. | | | | | |
| 24:* | | | | | |
| Obaro | --- | Oriental, arborvitae, Rocky Mountain juniper, Russian-olive, eastern redcedar, osageorange. | Siberian elm------ | --- | --- |
| Quinlan | --- | Eastern redcedar, osageorange. | --- | Chinese elm------- | --- |
| 25, 26, 27--- Olton | --- | Green ash, osageorange, Russian-olive, eastern redcedar, Arizona cypress, Rocky Mountain juniper. | Honeylocust, oriental arborvitae. | Siberian elm------ | --- |
| 28, 29--- Paloduro | --- | Osageorange, eastern redcedar, oriental arborvitae. | Honeylocust, Arizona cypress. | Siberian elm------ | --- |
| 30:* | | | | | |
| Paloduro | --- | Osageorange, eastern redcedar, oriental arborvitae. | Honeylocust, Arizona cypress. | Siberian elm------ | --- |
| Estacado | --- | Osageorange, eastern redcedar, oriental arborvitae, Rocky Mountain juniper. | --- | Siberian elm------ | --- |
| Potter. | | | | | |

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

| Map symbol and soil name | Trees having predicted 20-year average heights, in feet, of-- | | | | |
|---|---|---|---|---|---|
| | <8 | 8-15 | 16-25 | 26-35 | >35 |
| 31. Potter | | | | | |
| 32, 33---------- Pullman | --- | Osageorange, Russian-olive. | Eastern redcedar, honeylocust, Arizona cypress, oriental arborvitae. | Siberian elm------ | --- |
| 34. Randall | | | | | |
| 35---------- Spur | --- | Russian-olive, eastern redcedar. | Green ash, osageorange, oriental arborvitae, Arizona cypress. | Siberian elm, honeylocust. | --- |
| 36. Sweetwater | | | | | |
| 37, 38---------- Texroy | --- | Eastern redcedar. | --- | Austrian pine, red mulberry, ponderosa pine. | Eastern cottonwood, loblolly pine. |
| 39. Tivoli | | | | | |
| 40---------- Veal | --- | Oriental arborvitae, Rocky Mountain juniper, Russian-olive, osageorange, eastern redcedar. | Honeylocust, Siberian elm. | --- | --- |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

| Map symbol and soil name | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 1, 2--Acuff | Slight | Slight | Slight | Slight | Slight. |
| 3--Amarillo | Slight | Slight | Slight | Slight | Slight. |
| 4, 5--Amarillo | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 6:* | | | | | |
| Berda | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Potter | Severe: slope. | Severe: slope. | Severe: slope, small stones. | Severe: slope. | Severe: droughty, slope. |
| 7--Bippus | Slight | Slight | Slight | Slight | Slight. |
| 8--Bippus | Severe: floods. | Slight | Slight | Slight | Slight. |
| 9--Bippus | Slight | Slight | Slight | Slight | Slight. |
| 10--Darrouzett | Slight | Slight | Slight | Slight | Slight. |
| 11--Devol | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 12--Estacado | Slight | Slight | Slight | Slight | Slight. |
| 13, 14--Estacado | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 15:* | | | | | |
| Estacado | Slight | Slight | Severe: slope. | Slight | Slight. |
| Paloduro | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight | Moderate: slope. |
| 16--Guadalupe | Severe: floods. | Slight | Moderate: floods. | Slight | Moderate: floods. |
| 17--Likes | Slight | Slight | Moderate: slope. | Slight | Severe: droughty. |
| 18:* | | | | | |
| Likes | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight | Severe: droughty. |
| Tascosa | Severe: slope, small stones. | Severe: slope, small stones. | Severe: slope, small stones. | Severe: small stones. | Severe: small stones, droughty, slope. |
| 19--Lincoln | Severe: too sandy, floods. | Severe: too sandy. | Severe: too sandy, floods. | Severe: too sandy. | Severe: floods, droughty. |
| 20, 21--Mobeetie | Slight | Slight | Moderate: slope. | Slight | Slight. |

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

| Map symbol and soil name | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 22--Mobeetie | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight | Moderate: slope. |
| 23:* | | | | | |
| Mobeetie | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight | Moderate: slope. |
| Veal | Moderate: slope. | Moderate: slope. | Severe: slope. | Slight | Moderate: slope. |
| Potter | Moderate: small stones, slope. | Moderate: small stones, slope. | Severe: slope, small stones. | Moderate: dusty. | Severe: droughty. |
| 24:* | | | | | |
| Obaro | Moderate: slope. | Moderate: slope. | Severe: slope. | Severe: erodes easily. | Moderate: slope, thin layer. |
| Quinlan | Severe: depth to rock. | Severe: depth to rock. | Severe: slope, depth to rock. | Slight | Severe: thin layer. |
| 25--Olton | Slight | Slight | Slight | Slight | Slight. |
| 26, 27--Olton | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 28--Paloduro | Moderate: dusty. | Moderate: dusty. | Moderate: slope, dusty. | Moderate: dusty. | Slight. |
| 29--Paloduro | Moderate: dusty. | Moderate: dusty. | Severe: slope. | Moderate: dusty. | Slight. |
| 30:* | | | | | |
| Paloduro | Moderate: slope, dusty. | Moderate: slope, dusty. | Severe: slope. | Moderate: dusty. | Moderate: slope. |
| Estacado | Slight | Slight | Severe: slope. | Slight | Slight. |
| Potter | Moderate: small stones, slope. | Moderate: small stones, slope. | Severe: slope, small stones. | Moderate: dusty. | Severe: droughty. |
| 31--Potter | Moderate: small stones. | Moderate: small stones. | Severe: slope, small stones. | Moderate: dusty. | Severe: droughty. |
| 32--Pullman | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: percs slowly. | Slight | Slight. |
| 33--Pullman | Moderate: percs slowly. | Moderate: percs slowly. | Moderate: slope, percs slowly. | Slight | Slight. |
| 34--Randall | Severe: ponding. | Severe: ponding. | Severe: too clayey, ponding. | Severe: ponding. | Severe: ponding, too clayey. |
| 35--Spur | Severe: floods. | Moderate: floods. | Moderate: floods. | Moderate: floods. | Moderate: floods. |

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

| Map symbol and soil name | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| 36--Sweetwater | Severe: floods, wetness. | Severe: wetness. | Severe: floods, wetness. | Severe: wetness. | Severe: wetness, floods. |
| 37--Texroy | Slight | Slight | Slight | Slight | Slight. |
| 38--Texroy | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 39--Tivoli | Severe: slope, too sandy. | Severe: slope, too sandy. | Severe: slope, too sandy. | Severe: too sandy. | Severe: droughty, slope. |
| 40--Veal | Slight | Slight | Moderate: slope. | Slight | Slight. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

| Map symbol and soil name | Potential for habitat elements | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Wetland plants | Shallow water areas | Openland wildlife | Wetland wildlife | Rangeland wildlife |
| 1, 2----------<br>Acuff | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 3, 4, 5----------<br>Amarillo | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 6:* | | | | | | | | | |
| Berda---------- | Very poor | Very poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| Potter---------- | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| 7----------<br>Bippus | Fair | Good | Good | Good | Very poor | Very poor | Good | Very poor | Good. |
| 8----------<br>Bippus | Fair | Good | Good | Good | Very poor | Very poor | Good | Very poor | Good. |
| 9----------<br>Bippus | Fair | Good | Good | Good | Very poor | Very poor | Good | Very poor | Good. |
| 10----------<br>Darrouzett | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 11----------<br>Devol | Fair | Fair | Good | Fair | Poor | Very poor | Fair | Very poor | Fair. |
| 12, 13, 14---------<br>Estacado | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 15:* | | | | | | | | | |
| Estacado---------- | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Paloduro---------- | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 16----------<br>Guadalupe | Good | Good | Good | Good | Very poor | Very poor | Good | Very poor | Good. |
| 17----------<br>Likes | Poor | Fair | Good | Good | Very poor | Very poor | Fair | Very poor | Good. |
| 18:* | | | | | | | | | |
| Likes---------- | Poor | Fair | Good | Good | Very poor | Very poor | Fair | Very poor | Good. |
| Tascosa---------- | Poor | Poor | Fair | Poor | Very poor | Very poor | Poor | Very poor | Poor. |
| 19----------<br>Lincoln | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 20, 21----------<br>Mobeetie | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 22----------<br>Mobeetie | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 23:* | | | | | | | | | |
| Mobeetie---------- | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Veal---------- | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Potter---------- | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT--Continued

| Map symbol and soil name | Potential for habitat elements | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Wetland plants | Shallow water areas | Openland wildlife | Wetland wildlife | Rangeland wildlife |
| 24:* | | | | | | | | | |
| Obaro | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Quinlan | Poor | Poor | Fair | Poor | Very poor | Very poor | Fair | Very poor | Poor. |
| 25, 26, 27--- Olton | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 28, 29--- Paloduro | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 30:* | | | | | | | | | |
| Paloduro | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Estacado | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Potter | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| 31--- Potter | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| 32, 33--- Pullman | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| 34--- Randall | Poor | Poor | Fair | Poor | Poor | Fair | Poor | Poor | Poor. |
| 35--- Spur | Good | Good | Good | Good | Very poor | Very poor | Good | Very poor | Good. |
| 36--- Sweetwater | Poor | Fair | Good | Fair | Good | Good | Fair | Good | Fair. |
| 37, 38--- Texroy | Good | Good | Good | Good | Poor | Very poor | Good | Very poor | Good. |
| 39--- Tivoli | Poor | Poor | Fair | Poor | Very poor | Very poor | Poor | Very poor | Poor. |
| 40--- Veal | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

| Map symbol and soil name | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 1---------- Acuff | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Severe: low strength. | Slight. |
| 2---------- Acuff | Slight--------- | Slight--------- | Slight--------- | Moderate: slope. | Severe: low strength. | Slight. |
| 3, 4---------- Amarillo | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Slight. |
| 5---------- Amarillo | Slight--------- | Slight--------- | Slight--------- | Moderate: slope. | Slight--------- | Slight. |
| 6:* | | | | | | |
| Berda---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. |
| Potter---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: droughty, slope. |
| 7---------- Bippus | Slight--------- | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Slight. |
| 8---------- Bippus | Slight--------- | Severe: floods. | Severe: floods. | Severe: floods. | Moderate: floods. | Slight. |
| 9---------- Bippus | Slight--------- | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Slight. |
| 10---------- Darrouzett | Moderate: too clayey. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| 11---------- Devol | Severe: cutbanks cave. | Slight--------- | Slight--------- | Moderate: slope. | Slight--------- | Slight. |
| 12, 13---------- Estacado | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Severe: low strength. | Slight. |
| 14---------- Estacado | Slight--------- | Slight--------- | Slight--------- | Moderate: slope. | Severe: low strength. | Slight. |
| 15:* | | | | | | |
| Estacado--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: slope. | Severe: low strength. | Slight. |
| Paloduro--------- | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. |
| 16---------- Guadalupe | Moderate: floods. | Severe: floods. | Severe: floods. | Severe: floods. | Severe: floods. | Moderate: floods. |
| 17---------- Likes | Severe: cutbanks cave. | Slight--------- | Slight--------- | Moderate: slope. | Slight--------- | Severe: droughty. |
| 18:* | | | | | | |
| Likes---------- | Severe: cutbanks cave. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Severe: droughty. |
| Tascosa---------- | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: small stones, droughty, slope. |
| 19---------- Lincoln | Severe: cutbanks cave. | Severe: floods. | Severe: floods. | Severe: floods. | Severe: floods. | Severe: floods, droughty. |

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

| Map symbol and soil name | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 20--Mobeetie | Slight | Slight | Slight | Slight | Slight | Slight. |
| 21--Mobeetie | Slight | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 22--Mobeetie | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. |
| 23:* | | | | | | |
| Mobeetie | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. |
| Veal | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: low strength, slope. | Moderate: slope. |
| Potter | Moderate: large stones, slope. | Moderate: slope, large stones. | Moderate: slope, large stones. | Severe: slope. | Moderate: slope, large stones. | Severe: droughty. |
| 24:* | | | | | | |
| Obaro | Moderate: depth to rock, slope. | Moderate: slope. | Moderate: depth to rock, slope. | Severe: slope. | Severe: low strength. | Moderate: slope, thin layer. |
| Quinlan | Severe: depth to rock. | Moderate: depth to rock, slope. | Severe: depth to rock. | Severe: slope. | Moderate: slope. | Severe: thin layer. |
| 25, 26--Olton | Moderate: too clayey. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Severe: low strength. | Slight. |
| 27--Olton | Moderate: too clayey. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell, slope. | Severe: low strength. | Slight. |
| 28, 29--Paloduro | Slight | Slight | Slight | Moderate: slope. | Slight | Slight. |
| 30:* | | | | | | |
| Paloduro | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. |
| Estacado | Slight | Slight | Slight | Moderate: slope. | Severe: low strength. | Slight. |
| Potter | Moderate: large stones, slope. | Moderate: slope, large stones. | Moderate: slope, large stones. | Severe: slope. | Moderate: slope, large stones. | Severe: droughty. |
| 31--Potter | Moderate: large stones. | Moderate: large stones. | Moderate: large stones. | Moderate: slope, large stones. | Moderate: large stones. | Severe: droughty. |
| 32, 33--Pullman | Moderate: too clayey. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: shrink-swell. | Severe: low strength, shrink-swell. | Slight. |
| 34--Randall | Severe: cutbanks cave, ponding. | Severe: ponding, shrink-swell. | Severe: ponding, shrink-swell. | Severe: ponding, shrink-swell. | Severe: low strength, ponding, shrink-swell. | Severe: ponding, too clayey. |
| 35--Spur | Moderate: floods. | Severe: floods. | Severe: floods. | Severe: floods. | Severe: low strength, floods. | Moderate: floods. |
| 36--Sweetwater | Severe: cutbanks cave, wetness. | Severe: floods, wetness. | Severe: floods, wetness. | Severe: floods, wetness. | Severe: wetness, floods. | Severe: wetness, floods. |

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

| Map symbol and soil name | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| 37, 38---------- Texroy | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: low strength. | Slight. |
| 39---------- Tivoli | Severe: cutbanks cave, slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Severe: droughty, slope. |
| 40---------- Veal | Slight--------- | Slight--------- | Slight--------- | Slight--------- | Moderate: low strength. | Slight. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

| Map symbol and soil name | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 1, 2--Acuff | Slight | Moderate: seepage, slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| 3--Amarillo | Slight | Moderate: seepage. | Slight | Slight | Good. |
| 4, 5--Amarillo | Slight | Moderate: seepage, slope. | Slight | Slight | Good. |
| 6:* | | | | | |
| Berda | Severe: slope. | Severe: slope. | Severe: slope. | Severe: slope. | Poor: slope. |
| Potter | Severe: slope. | Severe: seepage, slope. | Severe: slope, large stones. | Severe: slope. | Poor: small stones, slope. |
| 7--Bippus | Slight | Slight | Slight | Slight | Fair: too clayey. |
| 8--Bippus | Moderate: floods. | Severe: floods. | Moderate: floods. | Moderate: floods. | Fair: too clayey. |
| 9--Bippus | Slight | Slight | Slight | Slight | Fair: too clayey. |
| 10--Darrouzett | Severe: percs slowly. | Slight | Severe: too clayey. | Slight | Poor: too clayey, hard to pack. |
| 11--Devol | Slight | Severe: seepage. | Severe: seepage. | Severe: seepage. | Fair: too sandy. |
| 12--Estacado | Slight | Moderate: seepage. | Moderate: too clayey. | Slight | Fair: too clayey. |
| 13, 14--Estacado | Slight | Moderate: seepage, slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| 15:* | | | | | |
| Estacado | Slight | Severe: slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| Paloduro | Moderate: slope. | Severe: slope. | Moderate: slope, too clayey. | Moderate: slope. | Fair: too clayey, slope. |
| 16--Guadalupe | Severe: floods. | Severe: seepage, floods. | Severe: floods, seepage. | Severe: floods, seepage. | Good. |
| 17--Likes | Slight | Severe: seepage. | Severe: seepage. | Severe: seepage. | Poor: seepage. |
| 18:* | | | | | |
| Likes | Moderate: slope. | Severe: seepage, slope. | Severe: seepage. | Severe: seepage. | Poor: seepage. |

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

| Map symbol and soil name | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 18:* | | | | | |
| Tascosa | Severe: slope. | Severe: seepage, slope. | Severe: seepage, slope. | Severe: seepage, slope. | Poor: small stones, slope. |
| 19 | | | | | |
| Lincoln | Severe: floods, poor filter. | Severe: seepage, floods. | Severe: floods, seepage, wetness. | Severe: floods, seepage. | Poor: too sandy, seepage. |
| 20, 21 | | | | | |
| Mobeetie | Slight | Severe: seepage. | Slight | Severe: seepage. | Good. |
| 22 | | | | | |
| Mobeetie | Moderate: slope. | Severe: seepage, slope. | Moderate: slope. | Severe: seepage. | Fair: slope. |
| 23:* | | | | | |
| Mobeetie | Moderate: slope. | Severe: seepage, slope. | Moderate: slope. | Severe: seepage. | Fair: slope. |
| Veal | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: slope. | Fair: slope. |
| Potter | Moderate: percs slowly, slope, large stones. | Severe: seepage, slope. | Severe: large stones. | Moderate: slope. | Poor: small stones. |
| 24:* | | | | | |
| Obaro | Severe: depth to rock. | Severe: depth to rock, slope. | Severe: depth to rock. | Severe: depth to rock. | Poor: area reclaim, thin layer. |
| Quinlan | Severe: depth to rock. | Severe: depth to rock, slope. | Severe: depth to rock. | Severe: depth to rock. | Poor: area reclaim, thin layer. |
| 25 | | | | | |
| Olton | Severe: percs slowly. | Slight | Moderate: too clayey. | Slight | Fair: too clayey. |
| 26, 27 | | | | | |
| Olton | Severe: percs slowly. | Moderate: slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| 28, 29 | | | | | |
| Paloduro | Slight | Moderate: seepage, slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| 30:* | | | | | |
| Paloduro | Moderate: slope. | Severe: slope. | Moderate: slope, too clayey. | Moderate: slope. | Fair: too clayey, slope. |
| Estacado | Slight | Severe: slope. | Moderate: too clayey. | Slight | Fair: too clayey. |
| Potter | Moderate: percs slowly, slope, large stones. | Severe: seepage, slope. | Severe: large stones. | Moderate: slope. | Poor: small stones. |
| 31 | | | | | |
| Potter | Moderate: percs slowly, large stones. | Severe: seepage, slope. | Severe: large stones. | Slight | Poor: small stones. |

See footnote at end of table.

TABLE 13.--SANITARY FACILITIES--Continued

| Map symbol and soil name | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| 32--Pullman | Severe: percs slowly. | Slight | Severe: too clayey. | Slight | Poor: too clayey, hard to pack. |
| 33--Pullman | Severe: percs slowly. | Moderate: slope. | Severe: too clayey. | Slight | Poor: too clayey, hard to pack. |
| 34--Randall | Severe: ponding, percs slowly. | Severe: ponding. | Severe: ponding, too clayey. | Severe: ponding. | Poor: too clayey, hard to pack, ponding. |
| 35--Spur | Severe: floods. | Severe: floods. | Severe: floods. | Severe: floods. | Fair: too clayey. |
| 36--Sweetwater | Severe: floods, wetness, poor filter. | Severe: seepage, floods, wetness. | Severe: floods, seepage, wetness. | Severe: floods, seepage, wetness. | Poor: too sandy, wetness. |
| 37--Texroy | Slight | Moderate: seepage. | Slight | Slight | Good. |
| 38--Texroy | Slight | Moderate: seepage, slope. | Slight | Slight | Good. |
| 39--Tivoli | Severe: poor filter, slope. | Severe: seepage, slope. | Severe: seepage, slope, too sandy. | Severe: seepage, slope. | Poor: seepage, too sandy, slope. |
| 40--Veal | Slight | Moderate: slope, seepage. | Slight | Slight | Fair: too clayey. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

| Map symbol and soil name | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| 1, 2---- Acuff | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 3, 4, 5---- Amarillo | Good | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 6:* | | | | |
| Berda---- | Poor: slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: slope. |
| Potter---- | Poor: slope. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones, slope. |
| 7, 8, 9---- Bippus | Fair: low strength, shrink-swell. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 10---- Darrouzett | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 11---- Devol | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: too sandy. |
| 12, 13, 14---- Estacado | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 15:* | | | | |
| Estacado---- | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| Paloduro---- | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey, slope. |
| 16---- Guadalupe | Good | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 17---- Likes | Good | Probable---- | Improbable: too sandy. | Fair: too sandy. |
| 18:* | | | | |
| Likes---- | Good | Probable---- | Improbable: too sandy. | Fair: too sandy, slopes. |
| Tascosa---- | Fair: slope. | Improbable: excess fines. | Probable---- | Poor: small stones, area reclaim, slope. |
| 19---- Lincoln | Good | Probable---- | Improbable: too sandy. | Poor: too sandy. |
| 20, 21---- Mobeetie | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones. |
| 22---- Mobeetie | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones, slope. |

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

| Map symbol and soil name | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| 23:* | | | | |
| Mobeetie | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones, slope. |
| Veal | Good | Improbable: excess fines. | Improbable: excess fines. | Severe: thin layer. |
| Potter | Fair: large stones. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones. |
| 24:* | | | | |
| Obaro | Poor: area reclaim, low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: area reclaim, thin layer. |
| Quinlan | Poor: area reclaim, thin layer. | Improbable: excess fines. | Improbable: excess fines. | Poor: area reclaim, thin layer. |
| 25, 26, 27--- Olton | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 28, 29--- Paloduro | Good | Improbable: excess fines. | Improbable: excess fines. | Good. |
| 30:* | | | | |
| Paloduro | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: slope. |
| Estacado | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| Potter | Fair: large stones. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones. |
| 31--- Potter | Fair: large stones. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones. |
| 32, 33--- Pullman | Poor: low strength, shrink-swell. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 34--- Randall | Good | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| 35--- Spur | Poor: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 36--- Sweetwater | Poor: wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| 37, 38--- Texroy | Fair: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| 39--- Tivoli | Fair: slope. | Probable | Improbable: too sandy. | Poor: too sandy, slope. |
| 40--- Veal | Good | Improbable: excess fines. | Improbable: excess fines. | Severe: thin layer. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

| Map symbol and soil name | Limitations for-- | | | Features affecting-- | | |
|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Irrigation | Terraces and diversions | Grassed waterways |
| 1---Acuff | Moderate: seepage. | Slight | Severe: no water. | Favorable | Favorable | Favorable. |
| 2---Acuff | Moderate: seepage. | Slight | Severe: no water. | Slope | Favorable | Favorable. |
| 3, 4---Amarillo | Moderate: seepage. | Moderate: piping. | Severe: no water. | Soil blowing | Soil blowing | Favorable. |
| 5---Amarillo | Moderate: seepage. | Moderate: piping. | Severe: no water. | Soil blowing, slope. | Soil blowing | Favorable. |
| 6:* | | | | | | |
| Berda | Severe: slope. | Severe: piping. | Severe: no water. | Slope | Slope | Slope. |
| Potter | Severe: seepage, slope. | Severe: large stones. | Severe: no water. | Large stones, droughty, slope. | Slope, large stones. | Large stones, slope, droughty. |
| 7---Bippus | Moderate: seepage. | Moderate: piping. | Severe: no water. | Soil blowing | Soil blowing | Favorable. |
| 8, 9---Bippus | Moderate: seepage. | Moderate: piping. | Severe: no water. | Favorable | Favorable | Favorable. |
| 10---Darrouzett | Slight | Moderate: hard to pack. | Severe: no water. | Favorable | Erodes easily | Erodes easily. |
| 11---Devol | Severe: seepage. | Severe: seepage, piping. | Severe: no water. | Soil blowing, slope, fast intake. | Too sandy, soil blowing. | Favorable. |
| 12, 13---Estacado | Moderate: seepage. | Slight | Severe: no water. | Favorable | Favorable | Favorable. |
| 14---Estacado | Moderate: seepage, slope. | Slight | Severe: no water. | Slope | Favorable | Favorable. |
| 15:* | | | | | | |
| Estacado | Moderate: seepage, slopes. | Slight | Severe: no water. | Slope | Favorable | Favorable. |
| Paloduro | Severe: slope. | Moderate: piping. | Severe: no water. | Slope | Slope | Slope. |
| 16---Guadalupe | Severe: seepage. | Severe: piping. | Severe: no water. | Soil blowing, floods. | Soil blowing | Favorable. |
| 17---Likes | Severe: seepage. | Severe: seepage, piping. | Severe: no water. | Droughty, fast intake, soil blowing. | Soil blowing | Droughty. |
| 18:* | | | | | | |
| Likes | Severe: seepage, slope. | Severe: seepage, piping. | Severe: no water. | Droughty, fast intake, soil blowing. | Too sandy, soil blowing, slope. | Slope, droughty. |
| Tascosa | Severe: seepage, slope. | Severe: seepage. | Severe: no water. | Droughty, slope. | Slope | Slope, droughty. |

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

| Map symbol and soil name | Limitations for-- | | | Features affecting-- | | |
|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Irrigation | Terraces and diversions | Grassed waterways |
| 19---------- Lincoln | Severe: seepage. | Severe: seepage, piping. | Severe: no water. | Droughty, fast intake, soil blowing, floods. | Soil blowing, too sandy. | Droughty. |
| 20---------- Mobeetie | Severe: seepage. | Severe: piping. | Severe: no water. | Soil blowing--- | Soil blowing--- | Favorable. |
| 21---------- Mobeetie | Severe: seepage. | Severe: piping. | Severe: no water. | Soil blowing, slope. | Soil blowing--- | Favorable. |
| 22---------- Mobeetie | Severe: seepage, slope. | Severe: piping. | Severe: no water. | Soil blowing, slope. | Slope, soil blowing. | Slope. |
| 23:* | | | | | | |
| Mobeetie---------- | Severe: seepage, slope. | Severe: piping. | Severe: no water. | Soil blowing, slope. | Slope, soil blowing. | Slope. |
| Veal---------- | Severe: slope. | Severe: piping. | Severe: no water. | Slope, soil blowing. | Slope, soil blowing. | Slope. |
| Potter---------- | Severe: seepage, slope. | Severe: large stones. | Severe: no water. | Large stones, droughty, slope. | Slope, large stones. | Large stones, slope, droughty. |
| 24:* | | | | | | |
| Obaro---------- | Severe: slope. | Severe: piping. | Severe: no water. | Depth to rock, slope, erodes easily. | Slope, depth to rock, erodes easily. | Slope, erodes easily, depth to rock. |
| Quinlan---------- | Severe: depth to rock, slope. | Severe: piping, thin layer. | Severe: no water. | Depth to rock, slope. | Slope, depth to rock. | Slope, depth to rock. |
| 25, 26---------- Olton | Slight--------- | Slight--------- | Severe: no water. | Favorable------ | Favorable------ | Favorable. |
| 27---------- Olton | Slight--------- | Slight--------- | Severe: no water. | Slope---------- | Favorable------ | Favorable. |
| 28, 29---------- Paloduro | Moderate: seepage, slope. | Moderate: piping. | Severe: no water. | Slope---------- | Favorable------ | Favorable. |
| 30:* | | | | | | |
| Paloduro---------- | Severe: slope. | Moderate: piping. | Severe: no water. | Slope---------- | Slope---------- | Slope. |
| Estacado---------- | Moderate: seepage, slope. | Slight--------- | Severe: no water. | Slope---------- | Favorable------ | Favorable. |
| Potter---------- | Severe: seepage, slope. | Severe: large stones. | Severe: no water. | Large stones, droughty, slope. | Slope, large stones. | Large stones, slope, droughty. |
| 31---------- Potter | Severe: seepage. | Severe: large stones. | Severe: no water. | Large stones, droughty, slope. | Large stones--- | Large stones, droughty. |
| 32, 33---------- Pullman | Slight--------- | Moderate: hard to pack. | Severe: no water. | Percs slowly, erodes easily. | Erodes easily, percs slowly. | Erodes easily, percs slowly. |
| 34---------- Randall | Slight--------- | Severe: hard to pack, ponding. | Severe: no water. | Ponding, slow intake, percs slowly. | Ponding, percs slowly. | Percs slowly. |

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

| Map symbol and soil name | Limitations for-- | | | Features affecting-- | | |
|---|---|---|---|---|---|---|
| | Pond reservoir areas | Embankments, dikes, and levees | Aquifer-fed excavated ponds | Irrigation | Terraces and diversions | Grassed waterways |
| 35---------- Spur | Moderate: seepage. | Severe: piping. | Severe: no water. | Floods--------- | Favorable------ | Favorable. |
| 36---------- Sweetwater | Severe: seepage. | Severe: seepage, piping, wetness. | Severe: cutbanks cave. | Wetness, floods. | Wetness, too sandy. | Wetness. |
| 37, 38---------- Texroy | Moderate: seepage. | Slight--------- | Severe: no water. | Favorable------ | Favorable------ | Favorable. |
| 39---------- Tivoli | Severe: seepage, slope. | Severe: seepage, piping. | Severe: no water. | Droughty, fast intake, soil blowing. | Slope, too sandy, soil blowing. | Slope, droughty. |
| 40---------- Veal | Moderate: seepage, slope. | Severe: piping. | Severe: no water. | Slope, soil blowing. | Soil blowing--- | Slope. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

| Map symbol and soil name | Depth | USDA texture | Classification | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| 1, 2 | 0-7 | Loam | CL | A-4, A-6 | 0 | 100 | 95-100 | 95-100 | 51-70 | 24-32 | 8-16 |
| Acuff | 7-42 | Clay loam, sandy clay loam, loam. | CL | A-6, A-7-6 | 0 | 100 | 95-100 | 95-100 | 65-75 | 28-45 | 12-25 |
| | 42-80 | Clay loam, sandy clay loam, loam. | CL | A-6, A-7-6 | 0 | 95-100 | 90-100 | 90-100 | 60-75 | 25-42 | 12-25 |
| 3, 4, 5 | 0-10 | Fine sandy loam | SM, SM-SC, CL-ML, ML | A-2-4, A-4 | 0 | 100 | 100 | 95-100 | 30-55 | 17-25 | 3-7 |
| Amarillo | 10-48 | Sandy clay loam, clay loam. | SC, SM-SC, CL, CL-ML | A-4, A-6 | 0 | 100 | 100 | 95-100 | 35-65 | 20-40 | 7-20 |
| | 48-80 | Sandy clay loam, clay loam. | SC, CL, SM-SC, CL-ML | A-4, A-6 | 0 | 90-100 | 90-100 | 65-98 | 35-70 | 20-35 | 7-17 |
| 6:* | | | | | | | | | | | |
| Berda | 0-10 | Loam | SC, CL, SM-SC, CL-ML | A-4, A-6 | 0-3 | 85-100 | 85-100 | 75-95 | 36-70 | 20-35 | 7-20 |
| | 10-60 | Loam, clay loam, sandy clay loam. | SC, CL, SM-SC, CL-ML | A-4, A-6 | 0 | 85-100 | 85-100 | 75-95 | 40-75 | 20-35 | 7-20 |
| Potter | 0-8 | Gravelly loam | CL, CL-ML | A-4, A-6 | 0-5 | 70-95 | 70-95 | 60-85 | 51-70 | 20-40 | 5-20 |
| | 8-60 | Variable | GC, SC, GM-GC, SM-SC | A-2-4, A-4, A-6, A-2-6 | 5-50 | 30-80 | 25-75 | 20-60 | 13-50 | 20-40 | 5-20 |
| 7 | 0-23 | Fine sandy loam | CL-ML, CL, SC, SM-SC | A-2-4, A-4 | 0 | 100 | 95-100 | 80-98 | 30-60 | 18-25 | 4-10 |
| Bippus | 23-80 | Clay loam, loam, sandy clay loam. | SC, CL, SM-SC, CL-ML | A-4, A-6 | 0 | 100 | 95-100 | 85-98 | 36-75 | 22-40 | 7-20 |
| 8, 9 | 0-6 | Clay loam | CL, SC, SM-SC, CL-ML | A-4, A-6 | 0 | 100 | 95-100 | 85-98 | 36-80 | 22-40 | 7-20 |
| Bippus | 6-80 | Clay loam, loam, sandy clay loam. | SC, CL, SM-SC, CL-ML | A-4, A-6 | 0 | 100 | 95-100 | 85-98 | 36-75 | 22-40 | 7-20 |
| 10 | 0-7 | Silty clay loam | CL | A-6, A-4 | 0 | 100 | 95-100 | 90-100 | 55-95 | 25-35 | 8-18 |
| Darrouzett | 7-52 | Silty clay loam, clay loam, clay. | CL, CH | A-6, A-7-6 | 0 | 98-100 | 90-100 | 90-100 | 70-98 | 35-55 | 18-32 |
| | 52-80 | Silty clay loam, clay loam, clay. | CL | A-6, A-4, A-7-6 | 0 | 95-100 | 85-100 | 80-100 | 60-92 | 25-50 | 8-30 |
| 11 | 0-12 | Loamy fine sand | SM | A-2-4, | 0 | 98-100 | 98-100 | 90-100 | 15-35 | --- | NP |
| Devol | 12-24 | Fine sandy loam | SM, ML, SM-SC, CL-ML | A-4, A-2-4 | 0 | 98-100 | 98-100 | 94-100 | 30-60 | <26 | NP-7 |
| | 24-80 | Loamy fine sand, fine sandy loam. | SM, ML, SM-SC, CL-ML | A-2-4, A-4 | 0 | 98-100 | 98-100 | 90-100 | 15-60 | <26 | NP-7 |
| 12, 13, 14 | 0-11 | Clay loam | CL | A-6, A-4 | 0 | 95-100 | 95-100 | 55-100 | 51-90 | 25-40 | 8-20 |
| Estacado | 11-30 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 95-100 | 95-100 | 85-100 | 55-90 | 29-45 | 12-25 |
| | 30-80 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 93-100 | 90-100 | 80-100 | 60-95 | 30-45 | 13-25 |
| 15:* | | | | | | | | | | | |
| Estacado | 0-11 | Clay loam | CL | A-6, A-4 | 0 | 95-100 | 95-100 | 55-100 | 51-90 | 25-40 | 8-20 |
| | 11-30 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 95-100 | 95-100 | 85-100 | 55-90 | 29-45 | 12-25 |
| | 30-80 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 93-100 | 90-100 | 80-100 | 60-95 | 30-45 | 13-25 |

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

| Map symbol and soil name | Depth | USDA texture | Classification | | Frag-ments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plas-ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| 15:* | | | | | | | | | | | |
| Paloduro | 0-15 | Clay loam | CL, SC | A-4, A-6 | 0 | 95-100 | 90-100 | 80-96 | 40-75 | 20-35 | 8-20 |
| | 15-80 | Loam, clay loam, sandy clay loam. | CL, SC | A-4, A-6 | 0 | 95-100 | 95-100 | 80-98 | 40-75 | 20-35 | 8-20 |
| 16 Guadalupe | 0-50 | Fine sandy loam | SM, SC, SM-SC | A-2-4, A-4 | 0 | 95-100 | 95-100 | 70-100 | 25-50 | 18-30 | 2-10 |
| | 50-80 | Fine sandy loam, loam. | SM, SM-SC | A-2-4, A-4 | 0 | 95-100 | 90-100 | 55-90 | 20-40 | <24 | NP-5 |
| 17 Likes | 0-80 | Loamy fine sand, fine sand. | SM, SP-SM, SM-SC | A-2-4 | 0-2 | 90-100 | 90-100 | 75-95 | 10-30 | <25 | NP-6 |
| 18:* | | | | | | | | | | | |
| Likes | 0-80 | Loamy fine sand | SM, SP-SM, SM-SC | A-2-4 | 0-2 | 90-100 | 90-100 | 75-95 | 10-30 | <25 | NP-6 |
| Tascosa | 0-7 | Gravelly fine sandy loam | SM, GM, GP-GC, GC | A-1, A-2-4 | 0-5 | 40-65 | 25-60 | 15-50 | 10-26 | 25-42 | 5-16 |
| | 7-14 | Very gravelly loam, very gravelly sandy loam, gravelly sandy loam. | SM, GM, GP-GC, GC | A-1, A-2-4 | 0-5 | 28-60 | 20-50 | 15-45 | 8-25 | 25-40 | 5-14 |
| | 14-50 | Very gravelly sandy loam, very gravelly loam, gravelly sandy loam. | GM, SM, GC, GP-GC | A-1, A-2-4 | 0-5 | 30-60 | 30-60 | 15-45 | 5-15 | <32 | NP-14 |
| 19 | 0-12 | Fine sand | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 98-100 | 82-98 | 5-20 | --- | NP |
| Lincoln | 12-80 | Stratified fine sand to clay loam. | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 98-100 | 82-100 | 5-35 | --- | NP |
| 20, 21, 22 Mobeetie | 0-80 | Fine sandy loam | CL-ML, SM-SC, SM, ML | A-4, A-2-4 | 0-5 | 90-100 | 90-100 | 75-95 | 25-65 | 18-26 | 2-7 |
| 23:* | | | | | | | | | | | |
| Mobeetie | 0-80 | Fine sandy loam | CL-ML, SM-SC, SM, ML | A-4, A-2-4 | 0-5 | 90-100 | 90-100 | 75-95 | 25-65 | 18-26 | 2-7 |
| Veal | 0-10 | Fine sandy loam | SM, SC, SM-SC | A-2-4, A-4 | 0 | 90-100 | 85-100 | 70-98 | 30-58 | 15-30 | 3-10 |
| | 10-19 | Sandy clay loam, clay loam, loam. | CL, SC, CL-ML, SM-SC | A-4, A-6 | 0-2 | 85-100 | 80-100 | 80-100 | 40-80 | 22-40 | 7-20 |
| | 19-60 | Clay loam, sandy clay loam, loam. | CL, SC, CL-ML, SM-SC | A-4, A-6 | 0-2 | 85-100 | 80-100 | 65-100 | 35-80 | 22-40 | 7-20 |
| Potter | 0-10 | Gravelly loam | CL, CL-ML | A-4, A-6 | 0-5 | 70-95 | 70-95 | 60-85 | 51-70 | 20-40 | 5-20 |
| | 10-60 | Variable | GC, SC, GM-GC, SM-SC | A-2-4, A-4, A-6, A-2-6 | 5-50 | 30-80 | 25-75 | 20-60 | 13-50 | 20-40 | 5-20 |
| 24:* | | | | | | | | | | | |
| Obaro | 0-25 | Loam | CL, CL-ML | A-4, A-6 | 0 | 95-100 | 90-100 | 90-98 | 75-90 | 25-40 | 7-20 |
| | 25-60 | Weathered bedrock | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Quinlan | 0-14 | Loam | CL, ML, CL-ML | A-4, A-6 | 0 | 100 | 95-100 | 90-100 | 51-97 | <37 | NP-14 |
| | 14-60 | Weathered bedrock | --- | --- | --- | --- | --- | --- | --- | --- | --- |

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

| Map symbol and soil name | Depth | USDA texture | Classification | | Fragments > 3 inches | Percentage passing sieve number-- | | | | Liquid limit | Plasticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unified | AASHTO | | 4 | 10 | 40 | 200 | | |
| | In | | | | Pct | | | | | Pct | |
| 25, 26, 27---- Olton | 0-17 | Clay loam---- | CL | A-4, A-6 | 0 | 100 | 95-100 | 85-100 | 55-80 | 25-40 | 8-22 |
| | 17-48 | Clay loam, silty clay loam, clay. | CL | A-6, A-7-6 | 0 | 95-100 | 90-100 | 90-100 | 60-95 | 35-50 | 18-32 |
| | 48-80 | Clay loam, sandy clay loam, loam. | CL | A-4, A-6, A-7-6 | 0 | 90-100 | 85-100 | 80-100 | 60-90 | 20-43 | 8-27 |
| 28, 29---- Paloduro | 0-12 | Loam---- | CL, SC | A-4, A-6 | 0 | 95-100 | 90-100 | 80-96 | 40-75 | 20-35 | 8-20 |
| | 12-80 | Loam, clay loam, sandy clay loam. | CL, SC | A-4, A-6 | 0 | 95-100 | 95-100 | 80-98 | 40-75 | 20-35 | 8-20 |
| 30:* | | | | | | | | | | | |
| Paloduro---- | 0-14 | Loam---- | CL, SC | A-4, A-6 | 0 | 95-100 | 90-100 | 80-96 | 40-75 | 20-35 | 8-20 |
| | 14-80 | Loam, clay loam, sandy clay loam. | CL, SC | A-4, A-6 | 0 | 95-100 | 95-100 | 80-98 | 40-75 | 20-35 | 8-20 |
| Estacado---- | 0-11 | Clay loam---- | CL | A-6, A-4 | 0 | 95-100 | 95-100 | 55-100 | 51-90 | 25-40 | 8-20 |
| | 11-24 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 95-100 | 95-100 | 85-100 | 55-90 | 29-45 | 12-25 |
| | 24-80 | Clay loam, sandy clay loam. | CL | A-6, A-7-6 | 0 | 93-100 | 90-100 | 80-100 | 60-95 | 30-45 | 13-25 |
| Potter---- | 0-4 | Gravelly loam---- | CL, CL-ML | A-4, A-6 | 0-5 | 70-95 | 70-95 | 60-85 | 51-70 | 20-40 | 5-20 |
| | 4-60 | Variable---- | GC, SC, GM-GC, SM-SC | A-2-4, A-4, A-6, A-2-6 | 5-50 | 30-80 | 25-75 | 20-60 | 13-50 | 20-40 | 5-20 |
| 31---- Potter | 0-4 | Loam---- | CL, CL-ML | A-4, A-6 | 0-5 | 70-95 | 70-95 | 60-85 | 51-70 | 20-40 | 5-20 |
| | 4-66 | Variable---- | GC, SC, GM-GC, SM-SC | A-2-4, A-4, A-6, A-2-6 | 5-50 | 30-80 | 25-75 | 20-60 | 13-50 | 20-40 | 5-20 |
| 32, 33---- Pullman | 0-6 | Clay loam---- | CL | A-6, A-7-6 | 0 | 100 | 100 | 95-100 | 70-95 | 30-50 | 15-30 |
| | 6-50 | Clay, silty clay | CL, CH | A-7-6 | 0 | 100 | 100 | 95-100 | 85-98 | 41-55 | 22-35 |
| | 50-80 | Clay loam, clay, silty clay. | CL | A-6, A-7-6 | 0 | 95-100 | 90-100 | 80-100 | 75-95 | 30-50 | 15-30 |
| 34---- Randall | 0-80 | Clay---- | CL, CH | A-7-6 | 0 | 100 | 100 | 95-100 | 75-98 | 41-70 | 22-45 |
| 35---- Spur | 0-14 | Clay loam---- | CL, CL-ML | A-4, A-6, A-7-6 | 0 | 100 | 95-100 | 90-100 | 51-95 | 25-45 | 7-25 |
| | 14-80 | Loam, clay loam, sandy clay loam. | CL, SC, SM-SC, CL-ML | A-4, A-6, A-7-6 | 0 | 100 | 95-100 | 90-100 | 45-95 | 22-45 | 7-25 |
| 36---- Sweetwater | 0-24 | Silty clay loam, sandy clay loam. | CL, CL-ML, SC, SM-SC | A-4, A-6 | 0 | 100 | 95-100 | 80-95 | 40-70 | 25-40 | 7-20 |
| | 24-80 | Loamy fine sand, fine sand. | SM | A-2-4 | 0 | 95-100 | 90-100 | 50-80 | 15-35 | <22 | NP-2 |
| 37, 38---- Texroy | 0-8 | Loam---- | CL | A-4, A-6 | 0 | 100 | 100 | 95-100 | 60-85 | 22-30 | 8-16 |
| | 8-65 | Loam, sandy clay loam, clay loam. | CL | A-6, A-7-6 | 0 | 100 | 100 | 95-100 | 60-90 | 25-45 | 11-25 |
| | 65-80 | Variable---- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 39---- Tivoli | 0-7 | Fine sand---- | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 95-100 | 80-100 | 5-25 | --- | NP |
| | 7-80 | Fine sand, sand | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 95-100 | 80-100 | 5-25 | --- | NP |
| 40---- Veal | 0-6 | Loam---- | CL, CL-ML, SC, SM-SC | A-4, A-6 | 0 | 90-100 | 85-100 | 70-98 | 36-75 | 20-35 | 5-17 |
| | 6-18 | Sandy clay loam, clay loam, loam. | CL, SC, CL-ML, SM-SC | A-4, A-6 | 0-2 | 85-100 | 80-100 | 80-100 | 40-80 | 22-40 | 7-20 |
| | 18-80 | Clay loam, sandy clay loam, loam. | CL, SC, CL-ML, SM-SC | A-4, A-6 | 0-2 | 85-100 | 80-100 | 65-100 | 35-80 | 22-40 | 7-20 |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

| Map symbol and soil name | Depth | Clay <2mm | Moist bulk density | Permeability | Available water capacity | Reaction | Shrink-swell potential | Erosion factors | | Wind erodibility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | K | T | | |
| | In | Pct | G/cm³ | In/hr | In/in | pH | | | | | Pct |
| 1, 2---------- | 0-7 | 13-30 | 1.30-1.55 | 0.6-2.0 | 0.12-0.18 | 6.6-7.8 | Low---------- | 0.28 | 5 | 5 | 1-2 |
| Acuff | 7-42 | 25-35 | 1.40-1.65 | 0.6-2.0 | 0.14-0.19 | 7.4-8.4 | Low---------- | 0.32 | | | |
| | 42-80 | 20-35 | 1.55-1.70 | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | Low---------- | 0.32 | | | |
| 3, 4, 5---------- | 0-10 | 10-18 | 1.35-1.60 | 2.0-6.0 | 0.11-0.15 | 6.6-7.8 | Low---------- | 0.24 | 5 | 3 | .5-1 |
| Amarillo | 10-48 | 20-35 | 1.30-1.65 | 0.6-2.0 | 0.14-0.18 | 7.4-8.4 | Low---------- | 0.32 | | | |
| | 48-80 | 20-35 | 1.40-1.80 | 0.6-2.0 | 0.10-0.15 | 7.9-8.4 | Low---------- | 0.32 | | | |
| 6:* | | | | | | | | | | | |
| Berda---------- | 0-10 | 15-35 | --- | 0.6-2.0 | 0.14-0.18 | 7.9-8.4 | Low---------- | 0.28 | 5 | 4L | --- |
| | 10-60 | 18-35 | --- | 0.6-2.0 | 0.14-0.18 | 7.9-8.4 | Low---------- | 0.28 | | | |
| Potter---------- | 0-8 | 18-25 | --- | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | Low---------- | 0.28 | 1 | --- | --- |
| | 8-60 | --- | --- | 0.6-6.0 | 0.-0.06 | 7.9-8.4 | Low---------- | ---- | | | |
| 7---------- | 0-23 | 10-18 | --- | 2.0-6.0 | 0.11-0.15 | 7.4-8.4 | Low---------- | 0.24 | 5 | 3 | 1-3 |
| Bippus | 23-80 | 20-35 | --- | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | Moderate----- | 0.28 | | | |
| 8, 9---------- | 0-6 | 15-35 | --- | 0.6-2.0 | 0.14-0.20 | 7.4-8.4 | Moderate----- | 0.28 | 5 | 6 | 1-3 |
| Bippus | 6-80 | 20-35 | --- | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | Moderate----- | 0.28 | | | |
| 10---------- | 0-7 | 22-35 | --- | 0.6-2.0 | 0.15-0.20 | 6.6-8.4 | Moderate----- | 0.32 | 5 | 7 | --- |
| Darrouzett | 7-52 | 35-45 | --- | 0.2-0.6 | 0.14-0.19 | 7.4-8.4 | Moderate----- | 0.37 | | | |
| | 52-80 | 35-45 | --- | 0.2-0.6 | 0.10-0.16 | 7.9-8.4 | Moderate----- | 0.37 | | | |
| 11---------- | 0-12 | 2-8 | 1.35-1.50 | 2.0-6.0 | 0.07-0.11 | 6.6-7.8 | Low---------- | 0.17 | 5 | 2 | <1 |
| Devol | 12-24 | 8-18 | 1.50-1.70 | 2.0-6.0 | 0.11-0.15 | 6.6-7.8 | Low---------- | 0.20 | | | |
| | 24-80 | 2-15 | 1.50-1.70 | 2.0-6.0 | 0.07-0.15 | 6.6-8.4 | Low---------- | 0.20 | | | |
| 12, 13, 14------- | 0-11 | 13-30 | 1.20-1.40 | 0.6-2.0 | 0.14-0.19 | 7.9-8.4 | Low---------- | 0.28 | 5 | 4L | --- |
| Estacado | 11-30 | 20-35 | 1.30-1.55 | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low---------- | 0.32 | | | |
| | 30-80 | 20-35 | 1.45-1.65 | 0.6-2.0 | 0.10-0.18 | 7.9-8.4 | Low---------- | 0.32 | | | |
| 15:* | | | | | | | | | | | |
| Estacado-------- | 0-11 | 13-30 | 1.20-1.40 | 0.6-2.0 | 0.14-0.19 | 7.9-8.4 | Low---------- | 0.28 | 5 | 4L | --- |
| | 11-30 | 20-35 | 1.30-1.55 | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low---------- | 0.32 | | | |
| | 30-80 | 20-35 | 1.45-1.65 | 0.6-2.0 | 0.10-0.18 | 7.9-8.4 | Low---------- | 0.32 | | | |
| Paloduro-------- | 0-15 | 18-35 | --- | 0.6-2.0 | 0.15-0.20 | 7.9-8.4 | Low---------- | 0.28 | 5 | 6 | --- |
| | 15-80 | 18-35 | --- | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low---------- | 0.28 | | | |
| 16---------- | 0-50 | 5-18 | --- | 2.0-6.0 | 0.10-0.15 | 7.9-8.4 | Low---------- | 0.28 | 4 | 3 | --- |
| Guadalupe | 50-80 | 5-18 | --- | 2.0-6.0 | 0.06-0.15 | 7.9-8.4 | Very low----- | 0.17 | | | |
| 17---------- | 0-80 | 5-15 | --- | 2.0-6.0 | 0.04-0.10 | 7.4-8.4 | Very low----- | 0.15 | 5 | 2 | --- |
| Likes | | | | | | | | | | | |
| 18:* | | | | | | | | | | | |
| Likes---------- | 0-80 | 5-15 | --- | 2.0-6.0 | 0.04-0.10 | 7.4-8.4 | Very low----- | 0.15 | 5 | 2 | --- |
| Tascosa--------- | 0-7 | 5-18 | --- | 0.6-2.0 | 0.06-0.12 | 7.9-8.4 | Very low----- | 0.10 | 4 | 8 | --- |
| | 7-14 | 5-18 | --- | 0.6-2.0 | 0.05-0.10 | 7.9-8.4 | Very low----- | 0.24 | | | |
| | 14-50 | 5-18 | --- | 2.0-6.0 | 0.03-0.07 | 7.9-8.4 | Very low----- | 0.24 | | | |
| 19---------- | 0-12 | 0-5 | --- | 6.0-20 | 0.02-0.08 | 7.4-8.4 | Low---------- | 0.17 | 5 | 1 | <.5 |
| Lincoln | 12-80 | 5-15 | --- | 6.0-20 | 0.02-0.08 | 7.9-8.4 | Low---------- | 0.17 | | | |
| 20, 21, 22------- | 0-80 | 10-18 | --- | 2.0-6.0 | 0.10-0.14 | 7.9-8.4 | Low---------- | 0.24 | 3 | 3 | --- |
| Mobeetie | | | | | | | | | | | |

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

| Map symbol and soil name | Depth | Clay <2mm | Moist bulk density | Permeability | Available water capacity | Reaction | Shrink-swell potential | Erosion factors | | Wind erodibility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | K | T | | |
| | In | Pct | G/cm³ | In/hr | In/in | pH | | | | | Pct |
| 23:* | | | | | | | | | | | |
| Mobeetie | 0-80 | 10-18 | --- | 2.0-6.0 | 0.10-0.14 | 7.9-8.4 | Low | 0.24 | 3 | 3 | --- |
| Veal | 0-10 | 10-20 | --- | 2.0-6.0 | 0.10-0.15 | 7.9-8.4 | Low | 0.24 | 4 | 3 | --- |
| | 10-19 | 20-35 | --- | 0.6-2.0 | 0.10-0.18 | 7.9-8.4 | Low | 0.28 | | | |
| | 19-60 | 20-35 | --- | 0.6-2.0 | 0.10-0.15 | 7.9-8.4 | Low | 0.28 | | | |
| Potter | 0-10 | 18-25 | --- | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | Low | 0.28 | 1 | --- | --- |
| | 10-60 | --- | --- | 0.6-6.0 | 0.-0.06 | 7.9-8.4 | Low | --- | | | |
| 24:* | | | | | | | | | | | |
| Obaro | 0-25 | 18-27 | --- | 0.6-2.0 | 0.12-0.16 | 7.9-8.4 | Low | 0.43 | 3 | 4L | <1 |
| | 25-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| Quinlan | 0-14 | 15-27 | 1.30-1.55 | 0.6-2.0 | 0.13-0.24 | 7.4-8.4 | Low | 0.32 | 2 | 4L | <1 |
| | 14-60 | --- | --- | --- | --- | --- | --- | --- | | | |
| 25, 26, 27 | 0-17 | 22-35 | --- | 0.6-2.0 | 0.15-0.20 | 6.6-8.4 | Moderate | 0.32 | 5 | 6 | 1-2 |
| Olton | 17-48 | 35-45 | --- | 0.2-0.6 | 0.14-0.19 | 7.4-8.4 | Moderate | 0.32 | | | |
| | 48-80 | 25-40 | --- | 0.2-0.6 | 0.10-0.16 | 7.9-8.4 | Moderate | 0.32 | | | |
| 28, 29 | 0-12 | 18-35 | --- | 0.6-2.0 | 0.15-0.20 | 7.9-8.4 | Low | 0.28 | 5 | 6 | --- |
| Paloduro | 12-80 | 18-35 | --- | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low | 0.28 | | | |
| 30:* | | | | | | | | | | | |
| Paloduro | 0-14 | 18-35 | --- | 0.6-2.0 | 0.15-0.20 | 7.9-8.4 | Low | 0.28 | 5 | 6 | --- |
| | 14-80 | 18-35 | --- | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low | 0.28 | | | |
| Estacado | 0-11 | 13-30 | 1.20-1.40 | 0.6-2.0 | 0.14-0.19 | 7.9-8.4 | Low | 0.28 | 5 | 4L | --- |
| | 11-24 | 20-35 | 1.30-1.55 | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low | 0.32 | | | |
| | 24-80 | 20-35 | 1.45-1.65 | 0.6-2.0 | 0.10-0.18 | 7.9-8.4 | Low | 0.32 | | | |
| Potter | 0-4 | 18-25 | --- | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | Low | 0.28 | 1 | --- | --- |
| | 4-60 | --- | --- | 0.6-6.0 | 0.-0.06 | 7.9-8.4 | Low | --- | | | |
| 31 | 0-4 | 18-25 | --- | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | Low | 0.28 | 1 | --- | --- |
| Potter | 4-66 | --- | --- | 0.6-6.0 | 0.-0.06 | 7.9-8.4 | Low | --- | | | |
| 32, 33 | 0-6 | 27-40 | 1.20-1.40 | 0.2-0.6 | 0.14-0.19 | 6.6-8.4 | Moderate | 0.37 | 5 | 6 | --- |
| Pullman | 6-50 | 40-55 | 1.35-1.65 | <0.06 | 0.12-0.17 | 7.4-8.4 | High | 0.37 | | | |
| | 50-80 | 38-50 | 1.45-1.75 | 0.06-0.2 | 0.10-0.16 | 7.9-8.4 | Moderate | 0.37 | | | |
| 34 | 0-80 | 40-60 | 1.20-1.45 | <0.06 | 0.12-0.18 | 7.4-8.4 | High | 0.32 | 5 | 4 | .5-2 |
| Randall | | | | | | | | | | | |
| 35 | 0-14 | 20-35 | --- | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | Moderate | 0.28 | 5 | 6 | --- |
| Spur | 14-80 | 20-35 | --- | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | Moderate | 0.28 | | | |
| 36 | 0-24 | 18-35 | --- | 0.2-0.6 | 0.16-0.20 | 7.4-8.4 | Low | 0.28 | 3 | 7 | --- |
| Sweetwater | 24-80 | 3-15 | --- | 6.0-20 | 0.04-0.10 | 7.9-8.4 | Very low | 0.17 | | | |
| 37, 38 | 0-8 | 15-27 | --- | 0.6-2.0 | 0.15-0.20 | 6.6-8.4 | Low | 0.28 | 5 | 5 | 1-3 |
| Texroy | 8-65 | 22-35 | --- | 0.6-2.0 | 0.15-0.20 | 7.4-8.4 | Low | 0.32 | | | |
| | 65-80 | --- | --- | --- | --- | --- | --- | --- | | | |
| 39 | 0-7 | 1-10 | 1.35-1.50 | 6.0-20.0 | 0.02-0.08 | 6.1-7.8 | Low | 0.17 | 5 | 1 | <1 |
| Tivoli | 7-80 | 1-10 | 1.50-1.70 | 6.0-20.0 | 0.02-0.08 | 6.1-8.4 | Low | 0.17 | | | |
| 40 | 0-6 | 15-35 | --- | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | Low | 0.28 | 4 | 4L | --- |
| Veal | 6-18 | 20-35 | --- | 0.6-2.0 | 0.10-0.18 | 7.9-8.4 | Low | 0.28 | | | |
| | 18-80 | 20-35 | --- | 0.6-2.0 | 0.10-0.15 | 7.9-8.4 | Low | 0.28 | | | |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[See text for definition of terms. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

| Map symbol and soil name | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | | |
| 1, 2--- Acuff | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 3, 4, 5--- Amarillo | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 6:* | | | | | | | | | | | |
| Berda--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| Potter--- | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 7--- Bippus | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 8--- Bippus | B | Rare | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 9--- Bippus | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 10--- Darrouzett | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 11--- Devol | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 12, 13, 14--- Estacado | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 15:* | | | | | | | | | | | |
| Estacado--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| Paloduro--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 16--- Guadalupe | B | Occasional | Very brief | Apr-Sep | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 17--- Likes | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 18:* | | | | | | | | | | | |
| Likes--- | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| Tascosa--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 19--- Lincoln | A | Frequent | Very brief to brief. | Apr-Oct | 5.0-8.0 | Apparent | Nov-May | >60 | --- | Low | Low. |
| 20, 21, 22--- Mobeetie | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 23:* | | | | | | | | | | | |
| Mobeetie--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| Veal--- | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| Potter--- | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 24:* | | | | | | | | | | | |
| Obaro--- | B | None | --- | --- | >6.0 | --- | --- | 20-40 | Soft | Low | Low. |
| Quinlan--- | C | None | --- | --- | >6.0 | --- | --- | 10-20 | Soft | Moderate | Low. |
| 25, 26, 27--- Olton | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

| Map symbol and soil name | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | | |
| 28, 29--Paloduro | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 30:* | | | | | | | | | | | |
| Paloduro | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| Estacado | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| Potter | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 31--Potter | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 32, 33--Pullman | D | None | --- | --- | >6.0 | --- | --- | >60 | --- | High | Low. |
| 34--Randall | D | None | --- | --- | +1-5.0 | Perched | May-Nov | >60 | --- | High | Low. |
| 35--Spur | B | Occasional | Very brief | Apr-Oct | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 36--Sweetwater | D | Common | Brief | Apr-Oct | +1-3.0 | Apparent | Dec-Mar | >60 | --- | High | Low. |
| 37, 38--Texroy | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |
| 39--Tivoli | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | Low | Low. |
| 40--Veal | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | Moderate | Low. |

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

| Soil name, report number, horizon, and depth in inches | Classification | | Grain size distribution[1] | | | | | | | | | Liquid limit[2] | Plasticity index[2] | Particle density | Shrinkage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Percentage passing sieve-- | | | | | | Percentage smaller than-- | | | | | | | | |
| | AASHTO | Unified | 5/8 inch | 3/8 inch | No. 4 | No. 10 | No. 40 | No. 200 | .05 mm | .005 mm | .002 mm | | | | Limit | Linear | Ratio |
| | | | | | | | | | | | | Pct | | G/cc | Pct | Pct | Pct |
| Acuff loam:[3] (S77TX-393-001) | | | | | | | | | | | | | | | | | |
| A1------- 0 to 7 | A-4 (05) | CL | 100 | 100 | 100 | 100 | 99 | 70 | 56 | 18 | 13 | 28 | 10 | 2.64 | 17.0 | 6.0 | 1.7 |
| B22t-----16 to 30 | A-6 (08) | CL | 100 | 100 | 100 | 100 | 99 | 68 | 57 | 24 | 21 | 30 | 15 | 2.68 | 15.0 | 8.0 | 1.8 |
| B24t-----42 to 56 | A-6 (04) | CL | 100 | 99 | 99 | 98 | 96 | 62 | 55 | 35 | 27 | 25 | 12 | 2.67 | 14.0 | 6.2 | 1.9 |
| Darrouzett sicl:[4] (S77TX-393-003) | | | | | | | | | | | | | | | | | |
| Ap------- 0 to 7 | A-6 (12) | CL | 100 | 100 | 100 | 100 | 100 | 94 | 83 | 30 | 23 | 31 | 14 | 2.64 | 16.0 | 7.6 | 1.8 |
| B22t-----17 to 28 | A-7-6(32) | CL | 100 | 100 | 100 | 100 | 99 | 94 | 86 | 46 | 40 | 48 | 32 | 2.70 | 11.0 | 16.8 | 2.0 |
| B25tca---52 to 66 | A-6 (18) | CL | 100 | 99 | 99 | 97 | 92 | 81 | 70 | 39 | 32 | 37 | 24 | 2.70 | 13.0 | 12.2 | 1.9 |
| Guadalupe fsl:[5] (S77TX-393-005) | | | | | | | | | | | | | | | | | |
| B22------16 to 26 | A-4 (00) | SM-SC | 100 | 100 | 100 | 100 | 100 | 43 | 31 | 10 | 8 | 23 | 4 | 2.66 | 19.0 | 2.3 | 1.7 |
| Likes lfs:[6] (S77TX-393-006) | | | | | | | | | | | | | | | | | |
| C1-------10 to 22 | A-2-4(00) | SP-SM | 100 | 100 | 100 | 100 | 95 | 10 | 7 | 4 | 3 | 20 | 2 | 2.63 | 18.0 | 0.0 | 1.6 |
| Veal loam:[7] (S77TX-393-009) | | | | | | | | | | | | | | | | | |
| A1------- 0 to 6 | A-4 (04) | CL | 100 | 100 | 99 | 98 | 96 | 67 | 52 | 15 | 11 | 29 | 8 | 2.63 | 19.0 | 4.8 | 1.7 |
| B22ca----18 to 35 | A-6 (06) | CL | 100 | 98 | 94 | 90 | 86 | 65 | 60 | 38 | 28 | 33 | 12 | 2.67 | 21.0 | 5.8 | 1.6 |

[1]For soil materials larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sieves, but these differences do not seriously affect the data.

[2]Liquid limit and plasticity index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

[3]Acuff loam:
From the junction of Texas 70 and Farm Road 282, north of Pampa, 14.5 miles north on Texas 70, then 100 feet west in rangeland.

[4]Darrouzett silt loam:
11 miles west of Miami on Farm Road 282, then 1.5 miles south on a county road, then 50 feet west in cropland.

[5]Guadalupe fine sandy loam:
From the junction of Texas 70 and Farm Road 283, 2.8 miles southeast on Farm Road 283, 0.45 mile northeast, 700 feet southeast, 150 feet east along creek.

[6]Likes loamy fine sand:
1.3 mile west of the Hemphill County line on county road north of Canadian River, then south 100 feet in rangeland.

[7]Veal loam:
From junction Texas 70 and Farm Road 282, 11.9 miles north on Texas 70, and 1.2 miles north on county road, then 50 feet east in rangeland.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

| Soil name | Family or higher taxonomic class |
|---|---|
| Acuff | Fine-loamy, mixed, thermic Aridic Paleustolls |
| Amarillo | Fine-loamy, mixed, thermic Aridic Paleustalfs |
| Berda | Fine-loamy, mixed, thermic Aridic Ustochrepts |
| Bippus | Fine-loamy, mixed, thermic Cumulic Haplustolls |
| Darrouzett | Fine, mixed, thermic Pachic Paleustolls |
| *Devol | Coarse-loamy, mixed, thermic Udic Haplustalfs |
| Estacado | Fine-loamy, mixed, thermic Calciorthidic Paleustolls |
| Guadalupe | Coarse-loamy, mixed, thermic Fluventic Ustochrepts |
| Likes | Mixed, thermic Typic Ustipsamments |
| Lincoln | Sandy, mixed, thermic Typic Ustifluvents |
| Mobeetie | Coarse-loamy, mixed, thermic Aridic Ustochrepts |
| Obaro | Fine-silty, mixed, thermic Typic Ustochrepts |
| Olton | Fine, mixed, thermic Aridic Paleustolls |
| Paloduro | Fine-loamy, mixed, thermic Aridic Haplustolls |
| Potter | Loamy, carbonatic, thermic, shallow Ustollic Calciorthids |
| Pullman | Fine, mixed, thermic Torrertic Paleustolls |
| Quinlan | Loamy, mixed, thermic, shallow Typic Ustochrepts |
| Randall | Fine, montmorillonitic, thermic Udic Pellusterts |
| Spur | Fine-loamy, mixed, thermic Fluventic Haplustolls |
| Sweetwater | Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), thermic Fluvaquentic Haplaquolls |
| *Tascosa | Loamy-skeletal, mixed, thermic Aridic Calciustolls |
| Texroy | Fine-loamy, mixed, thermic Pachic Argiustolls |
| Tivoli | Mixed, thermic Typic Ustipsamments |
| Veal | Fine-loamy, carbonatic, thermic Aridic Ustochrepts |

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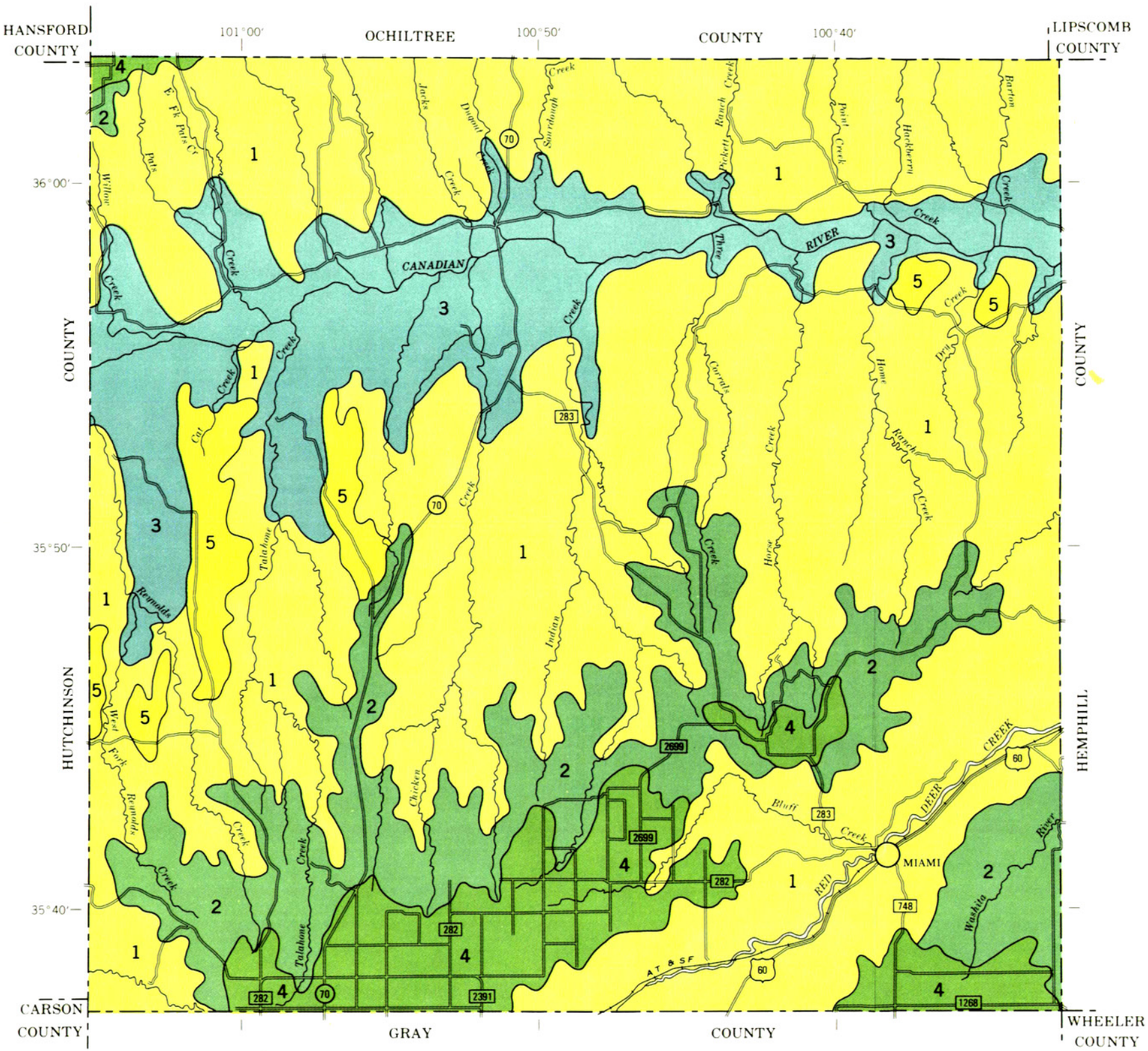



## LEGEND

| | |
|---|---|
| 1 | MOBEETIE-POTTER-BERDA: Deep and very shallow, gently sloping to steep, moderately and moderately rapidly permeable, loamy soils; on uplands |
| 2 | ESTACADO-PALODURO: Deep, nearly level to rolling, moderately permeable, loamy soils; on uplands |
| 3 | LIKES-LINCOLN-TIVOLI: Deep, nearly level to hilly, moderately rapidly to rapidly permeable, sandy soils; on uplands and bottom lands |
| 4 | PULLMAN-DARROUZETT-OLTON: Deep, nearly level to gently sloping, moderately slowly and very slowly permeable, loamy soils; on uplands |
| 5 | AMARILLO-ACUFF-VEAL: Deep, nearly level to gently sloping, moderately permeable, loamy soils; on uplands |

Compiled 1980

*Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.*

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

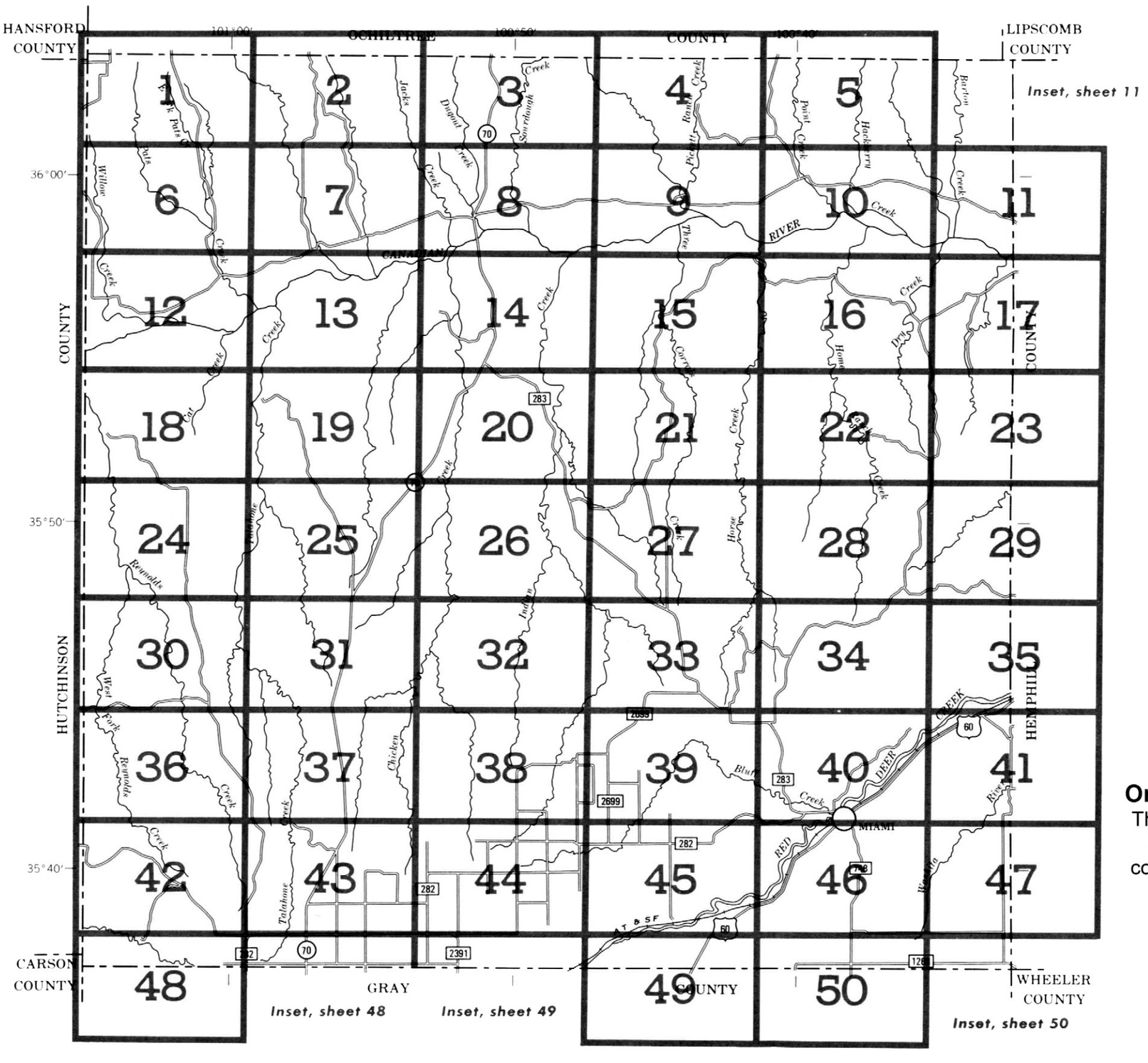
# GENERAL SOIL MAP

## ROBERTS COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km




**Original text from each individual map sheet read:**
This map is compiled on 1975 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

## INDEX TO MAP SHEETS

ROBERTS COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

# CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

## CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label) — Hedley Airstrip

- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 175
- State — 70
- County, farm or ranch — 1263

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

## WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

## SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CnB, WaC2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

# SOIL LEGEND

Map symbols will be published as arabic numbers. Most units in the legend are narrowly defined. Soil names followed by the superscript 1/ are broadly defined units. These units were mapped at a lower intensity and in larger delineations, but mapping has been controlled well enough to be interpreted for the expected use of the soils.

| SYMBOL | NAME |
|---|---|
| 1 | Acuff loam, 1 to 3 percent slopes |
| 2 | Acuff loam, 3 to 5 percent slopes |
| 3 | Amarillo fine sandy loam, 0 to 1 percent slopes |
| 4 | Amarillo fine sandy loam, 1 to 3 percent slopes |
| 5 | Amarillo fine sandy loam, 3 to 5 percent slopes |
| 6 | Berda-Potter association, steep 1/ |
| 7 | Bippus fine sandy loam, 1 to 3 percent slopes |
| 8 | Bippus clay loam, 0 to 1 percent slopes |
| 9 | Bippus clay loam, 1 to 3 percent slopes |
| 10 | Darrouzett silty clay loam, 0 to 1 percent slopes |
| 11 | Devol loamy fine sand, 3 to 8 percent slopes |
| 12 | Estacado clay loam, 0 to 1 percent slopes |
| 13 | Estacado clay loam, 1 to 3 percent slopes |
| 14 | Estacado clay loam, 3 to 5 percent slopes |
| 15 | Estacado-Paloduro association, rolling 1/ |
| 16 | Guadalupe fine sandy loam, occasionally flooded |
| 17 | Likes loamy fine sand, 1 to 8 percent slopes |
| 18 | Likes-Tascosa association, hilly 1/ |
| 19 | Lincoln fine sand, frequently flooded |
| 20 | Mobeetie fine sandy loam, 1 to 3 percent slopes |
| 21 | Mobeetie fine sandy loam, 3 to 5 percent slopes |
| 22 | Mobeetie fine sandy loam, 5 to 12 percent slopes |
| 23 | Mobeetie-Veal-Potter association, rolling 1/ |
| 24 | Obaro-Quinlan association, rolling 1/ |
| 25 | Olton clay loam, 0 to 1 percent slopes |
| 26 | Olton clay loam, 1 to 3 percent slopes |
| 27 | Olton clay loam, 3 to 5 percent slopes |
| 28 | Paloduro loam, 3 to 5 percent slopes |
| 29 | Paloduro loam, 5 to 8 percent slopes |
| 30 | Paloduro-Estacado-Potter association, rolling 1/ |
| 31 | Potter loam, 3 to 12 percent slopes |
| 32 | Pullman clay loam, 0 to 1 percent slopes |
| 33 | Pullman clay loam, 1 to 3 percent slopes |
| 34 | Randall clay |
| 35 | Spur clay loam, occasionally flooded |
| 36 | Sweetwater silty clay loam |
| 37 | Texroy loam, 0 to 1 percent slopes |
| 38 | Texroy loam, 1 to 3 percent slopes |
| 39 | Tivoli fine sand |
| 40 | Veal loam, 1 to 5 percent slopes |

ROBERTS COUNTY, TEXAS — SHEET NUMBER 1

2 125 000 FEET

750 000 FEET

HANSFORD COUNTY

OCHILTREE COUNTY

HUTCHINSON COUNTY

Pats Creek

East Fork

(Joins sheet 2)

(Joins sheet 6)

735 000 FEET

2 150 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 2

(2)

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0

0

1000

2000

3000

4000

5000

2 180 000 FEET

750 000 FEET

OCHILTREE COUNTY

(Joins sheet 1)

(Joins sheet 3)

235 000 FEET

2 155 000 FEET

(Joins sheet 7)

Government Canyon

Jocks Creek

ROBERTS COUNTY, TEXAS — SHEET NUMBER 3

3

2 185 000 FEET

750 000 FEET

OCHILTREE COUNTY

Sourdough Creek

Dugout Creek

Sourdough Creek

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 8)

735 000 FEET

2 210 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 4

(4)

N

2 235 000 FEET

750 000 FEET

OCHILTREE COUNTY

(Joins sheet 3)

Northwest Fork

Creek

Ranch

Pickett

(Joins sheet 5)

735 000 FEET

2 210 000 FEET

(Joins sheet 9)

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

2 240 000 FEET

750 000 FEET

OCHILTREE COUNTY

CALICHE PIT

Creek

Creek

Northwest Fork

Point

Tandy Mesa

Hackberry

(Joins sheet 4)

(Joins inset, sheet 11)

(Joins sheet 10)

2 265 000 FEET

735 000 FEET

5

N

2 Miles

10000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 6

6

N

(Joins sheet 1)

2 150 000 FEET

730 000 FEET

HUTCHINSON COUNTY

Willow Creek

Pats Creek

Post Fork

Pats Creek

Willow Creek

2 125 000 FEET

(Joins sheet 12)

(Joins sheet 7)

715 000 FEET

2 Miles

10 000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 7

7

2 155 000 FEET

730 000 FEET

(Joins sheet 2)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 13)

2 180 000 FEET

715 000 FEET

Jocks Creek

Government Canyon

CANADIAN RIVER

N

2 Miles

10000 Feet

Scale 1:24 000

5000

0

1

½

0

1000

2000

3000

4000

5000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 8

8

N

(Joins sheet 3)

2 210 000 FEET

730 000 FEET

(Joins sheet 7)

(Joins sheet 9)

715 000 FEET

2 185 000 FEET

(Joins sheet 14)

West Dugout Creek

Jocks Creek

Dugout Creek

Creek

Sourdough Creek

CANADIAN RIVER

Chicken Creek

Indian Creek

2 Miles

10 000 Feet

Scale 1:24 000

5000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 9

9

N

2 210 000 FEET

730 000 FEET

(Joins sheet 4)

(Joins sheet 10)

(Joins sheet 8)

(Joins sheet 15)

2 235 000 FEET

715 000 FEET

Ranch Creek

Pickett

RIVER

CANADIAN

Corrals Creek

Three

Horse Creek

Scale 1:24000

2 Miles 1

10000 Feet 5000 0

ROBERTS COUNTY, TEXAS — SHEET NUMBER 10

10

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 5)

(Joins sheet 9)

2 265 000 FEET

730 000 FEET

715 000 FEET

2 240 000 FEET

(Joins sheet 16)

(Joins sheet 11)

Point Creek

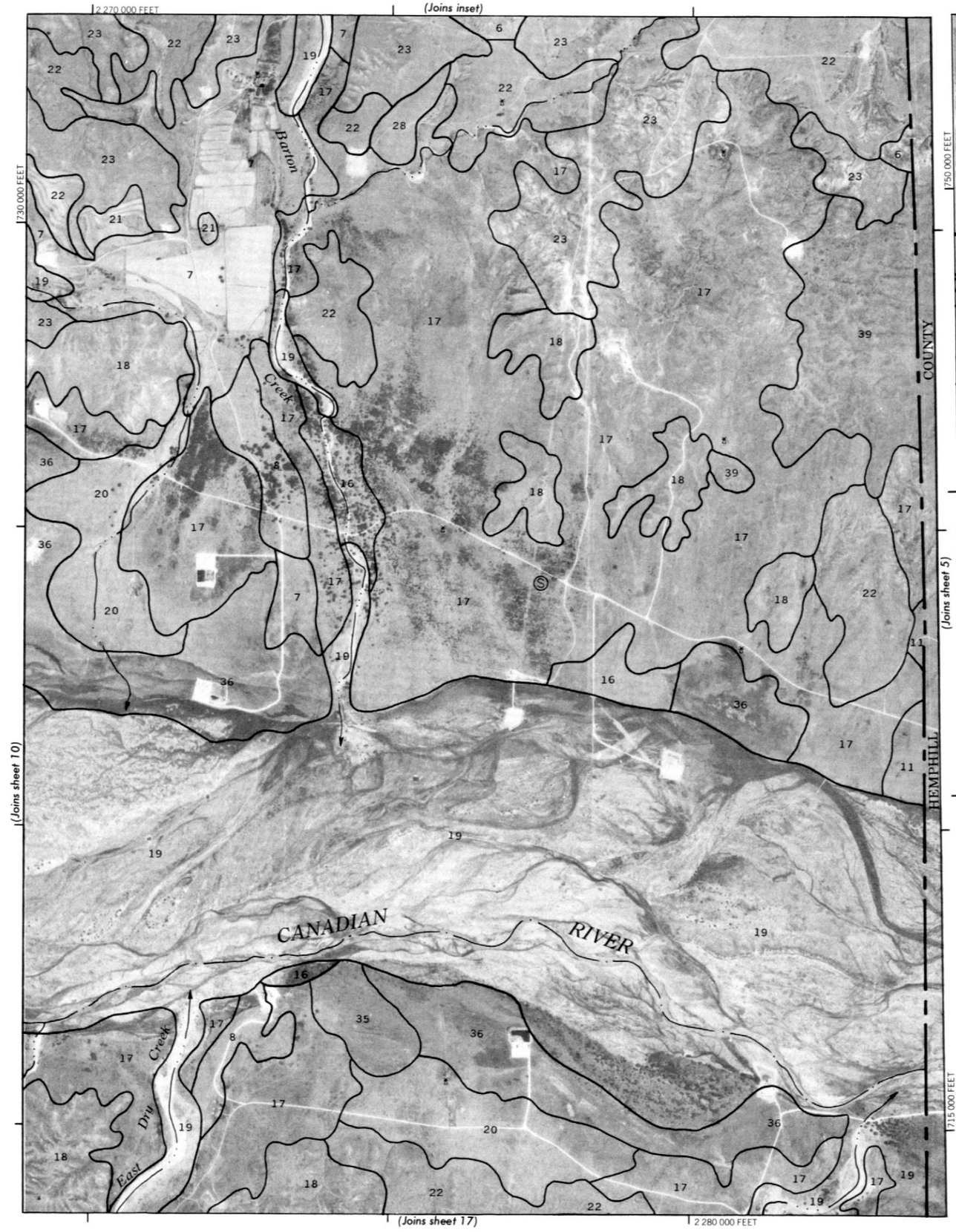
17 Creek

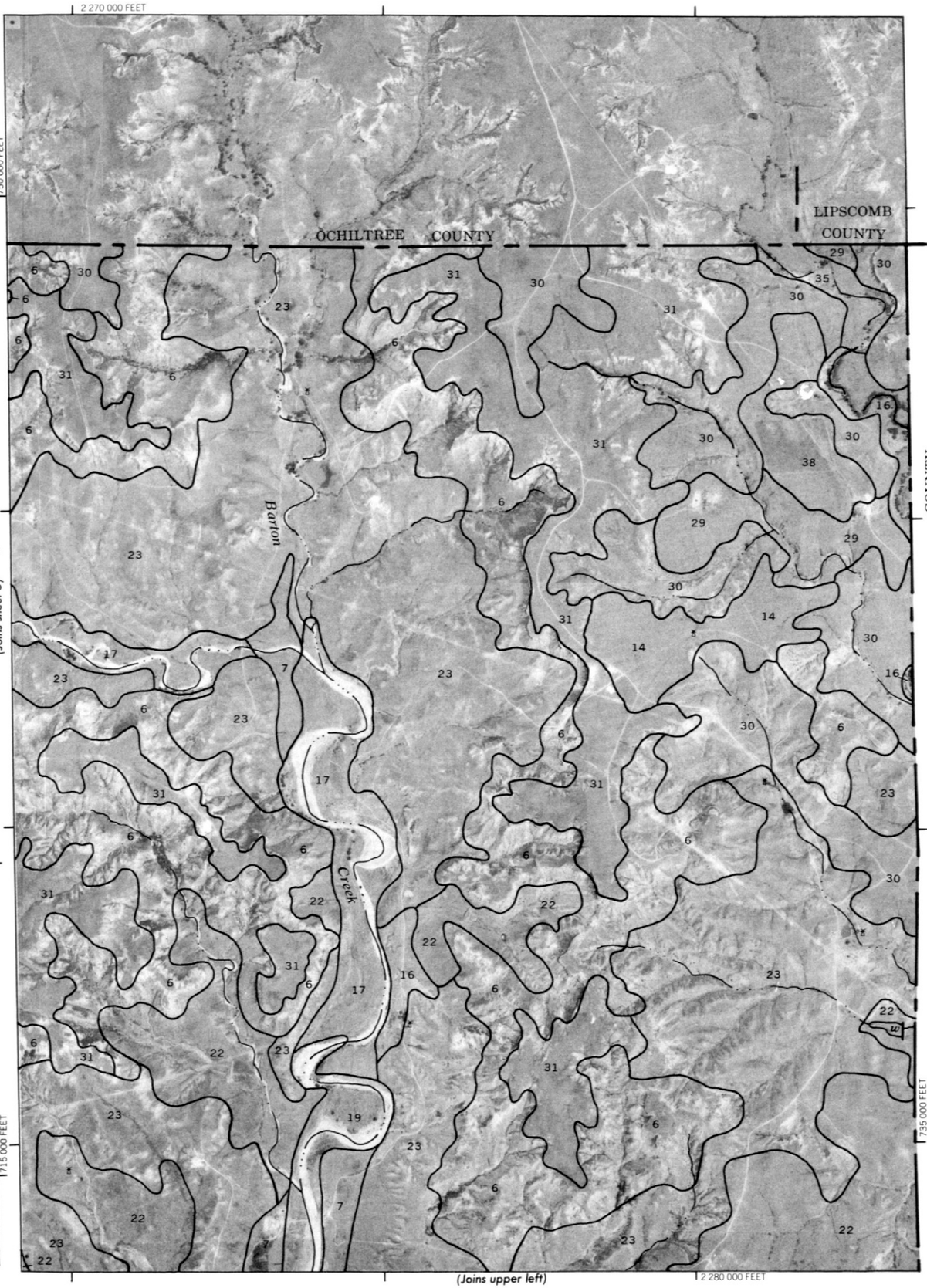
Hackberry Creek

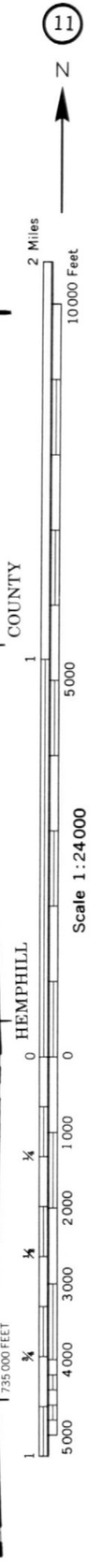
CANADIAN RIVER

Horse Creek

Home Ranch Creek


2 270 000 FEET
(Joins inset)
730 000 FEET
Barton Creek
COUNTY
HEMPHILL
(Joins sheet 10)
CANADIAN RIVER
Dry Creek
East
715 000 FEET
(Joins sheet 17)
2 280 000 FEET


2 270 000 FEET
750 000 FEET
OCHILTREE COUNTY
LIPSCOMB COUNTY
Barton Creek
COUNTY
HEMPHILL
(Joins sheet 5)
735 000 FEET
(Joins upper left)
2 280 000 FEET


11
N
2 Miles
10000 Feet
Scale 1:24000
5000
0
1000
2000
3000
4000
5000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 12

12

N

(Joins sheet 6)

2 150 000 FEET

2 Miles

10000 Feet

Scale 1:24000

1 0 1 2 3 4 5000

5000 4000 3000 2000 1000 0 0

710 000 FEET

695 000 FEET

2 125 000 FEET

(Joins sheet 18)

(Joins sheet 13)

HUTCHINSON COUNTY

CANADIAN RIVER

Willow Creek

Prats Creek

Garden Springs

Henry Spring

Cat Creek

ROBERTS COUNTY, TEXAS — SHEET NUMBER 13

13

N

2 155 000 FEET

(Joins sheet 7)

2 210 000 FEET

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 19)

2 180 000 FEET

1 695 000 FEET

CANADIAN RIVER

Creek

Tallahone Creek

Dry Creek

2 Miles

10000 Feet

Scale 1:24000

1 0 1 0

5000 4000 3000 2000 1000 0

14

N

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

(Joins sheet 8)

2 210 000 FEET

710 000 FEET

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 20)

2 185 000 FEET

695 000 FEET

CANADIAN RIVER

Blankinship Ranch Airfield (Pvt)

Creek

Chicken Creek

Indian Creek

70

283

ROBERTS COUNTY, TEXAS — SHEET NUMBER 15

15

2 210 000 FEET

(Joins sheet 9)

710 000 FEET

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 21)

2 235 000 FEET

695 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

Creek

Corrals

Three

Horse Creek

ROBERTS COUNTY, TEXAS — SHEET NUMBER 16

16

N

(Joins sheet 10)

2 265 000 FEET

710 000 FEET

(Joins sheet 15)

(Joins sheet 17)

2 240 000 FEET

695 000 FEET

(Joins sheet 22)

Creek

Ranch

Home

Dry

East

Horse

2 Miles 1

10000 Feet 5000

Scale 1:24000

0 0

¼ ¼

½ ½

¾ ¾

1 1

1000 2000 3000 4000 5000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 17

17

2 270 000 FEET

(Joins sheet 11)

710 000 FEET

(Joins sheet 16)

(Joins sheet 23)

2 295 000 FEET

695 000 FEET

HEMPHILL COUNTY

Creek

Dry

East

N

2 Miles

10000 Feet

Scale 1:24000

1 0 1/4 1/2 3/4 1 5000 4000 3000 2000 1000 0

18

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 0 1000 2000 3000 4000 5000

(Joins sheet 12)

2 150 000 FEET

690 000 FEET

675 000 FEET

2 125 000 FEET

(Joins sheet 24)

(Joins sheet 19)

CANADIAN RIVER

HUTCHINSON COUNTY

Reynolds Creek

Cat Creek

ROBERTS COUNTY, TEXAS — SHEET NUMBER 19

19

2 155 000 FEET

(Joins sheet 13)

690 000 FEET

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 25)

2 180 000 FEET

675 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

Creek

Tallahone

Dry

GRAVEL PIT

GRAVEL PIT

30

29

31

32

(20)

ROBERTS COUNTY, TEXAS — SHEET NUMBER 20

20

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 1000 2000 3000 4000 5000

(Joins sheet 14)

2 210 000 FEET

690 000 FEET

(Joins sheet 19)

(Joins sheet 21)

675 000 FEET

2 185 000 FEET

(Joins sheet 26)

Creek

Chicken

Indian

(Joins sheet 15)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 27)

2 210 000 FEET

690 000 FEET

675 000 FEET

2 235 000 FEET

Creek

Horse

Corrals

Three

Creek

Horse

Creek

21

N

Scale 1:24000

2 Miles

10000 Feet

5000

N

2 Miles

10000 Feet

Scale 1:24000

1 5000 0 0 1000 2000 3000 4000 5000

(Joins sheet 16)

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 28)

2 265 000 FEET

690 000 FEET

675 000 FEET

2 240 000 FEET

East Dry Creek

Home Ranch

Creek

(Joins sheet 17)

2 270 000 FEET

690 000 FEET

(Joins sheet 22)

(Joins sheet 29)

2 295 000 FEET

675 000 FEET

HEMPHILL COUNTY

Washburn Arroyo

100

101

8

9

2

3

23

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

(24)

N

(Joins sheet 18)

2 150 000 FEET

675 000 FEET

Reynolds Creek

HUTCHINSON COUNTY

West Fork Reynolds Creek

Reynolds Creek

Tallahone Creek

207

206

181

180

154

(Joins sheet 25)

660 000 FEET

2 125 000 FEET

(Joins sheet 30)

2 Miles

10000 Feet

Scale 1:24000

5000 4000 3000 2000 1000 0 0 ¼ ½ ¾ 1

ROBERTS COUNTY, TEXAS — SHEET NUMBER 25

2 155 000 FEET

675 000 FEET

(Joins sheet 19)

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 31)

2 180 000 FEET

655 000 FEET

Tallahone Creek

Dry Creek

Dry Creek

25

N

Scale 1:24000

2 Miles 1

10000 Feet 5000 0

26

N

Scale 1:24000

2 Miles 10000 Feet

1 5000

(Joins sheet 20)

2 210 000 FEET

675 000 FEET

660 000 FEET

2 185 000 FEET

(Joins sheet 32)

(Joins sheet 25)

(Joins sheet 27)

Creek

Creek

Chicken

Indian

283

283

6 7 53 54 55 75 51 50 25 67

(Joins sheet 21)

2 210 000 FEET

675 000 FEET

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 33)

2 235 000 FEET

655 000 FEET

Corrals Creek

Three Horse Creek

Horse Creek

75

76

46

47

283

27

N

2 Miles 1 0 1

10000 Feet 5000 0 5000

Scale 1:24000

¼ ¼ ¼ ¼

0 1000 2000 3000 4000

28

ROBERTS COUNTY, TEXAS — SHEET NUMBER 28

N

Scale 1:24000

2 Miles 1 0 1

10000 Feet 5000 0 5000

(Joins sheet 22)

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 34)

2 265 000 FEET

675 000 FEET

660 000 FEET

2 240 000 FEET

Creek

Ranch

Horse Creek

54

55

56

37

36

35

40

(Joins sheet 23)

2 270 000 FEET

675 000 FEET

(Joins sheet 28)

Arroyo

Washburn

South

Simmons Creek

82 83 63 62 58 59 33 32

HEMPHILL COUNTY

(Joins sheet 35)

2 295 000 FEET

655 000 FEET

29

N

2 Miles

10000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 30

30

N

Scale 1:24000

2 Miles 10000 Feet

1 5000

(Joins sheet 24)

2 150 000 FEET

655 000 FEET

640 000 FEET

2 125 000 FEET

(Joins sheet 36)

(Joins sheet 31)

HUTCHINSON COUNTY

Reynolds Creek

Reynolds Creek

Tallahone Creek

West Fork

208 205 182 179 156

209 204 183 178 157

210 203 184 177 158

211 202 185 176 159

ROBERTS COUNTY, TEXAS — SHEET NUMBER 31



2 155 000 FEET

655 000 FEET

(Joins sheet 25)

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 37)

2 180 000 FEET

640 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

1 0 1 5000

Tallahone Creek

Chicken Creek

32

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

(Joins sheet 26)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 38)

2 210 000 FEET

655 000 FEET

640 000 FEET

2 185 000 FEET

Creek

Creek

Chicken

Indian

2 210 000 FEET

655 000 FEET

(Joins sheet 27)

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 39)

2 235 000 FEET

640 000 FEET

N

Scale 1:24000

2 Miles

10000 Feet

5000

Willis Clark Airfield (Pvt)

Horse Creek

42

41

20

19

11

131

283

2699

34

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 0

¼ 1000 ½ 2000 ¾ 3000 1 4000 1¼ 5000

(Joins sheet 28)

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 40)

2 265 000 FEET

655 000 FEET

640 000 FEET

2 240 000 FEET

Home Ranch Creek

40 37 36 35

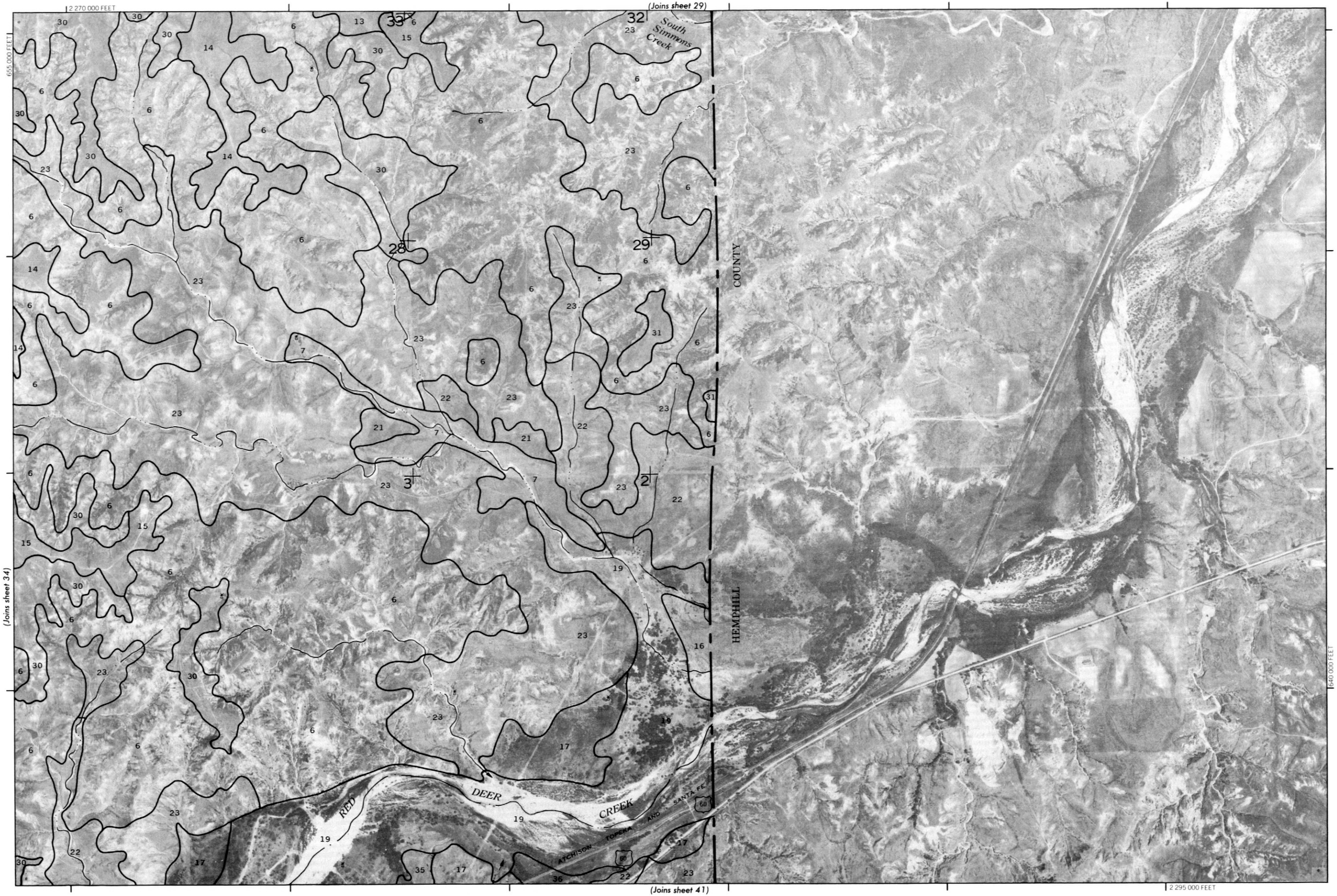
21 24 25

130 99 98 9 8 7 6

(Joins sheet 29)

2 270 000 FEET

655 000 FEET




(Joins sheet 34)

(Joins sheet 41)

640 000 FEET

2 295 000 FEET

35

N

2 Miles

10000 Feet

Scale 1:24000

36

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 30)

2 150 000 FEET

635 000 FEET

620 000 FEET

2 125 000 FEET

(Joins sheet 42)

(Joins sheet 37)

COUNTY

HUTCHINSON

West Fork Reynolds Creek

Reynolds Creek

Reynolds Creek

212 201 186 175 160

213 200 187 174

214 199 188 173 162

215 163

(37)

N

2 155 000 FEET

635 000 FEET

(Joins sheet 31)

(Joins sheet 38)

(Joins sheet 36)

(Joins sheet 43)

620 000 FEET

2 180 000 FEET

149

134

148

135

14

136

121

110

137

119

111

Creek

Tallahone Creek

Chicken Creek

Chicken Creek

2 Miles

10000 Feet

Scale 1:24000

38

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 0

¼ 1000 ½ 2000 ¾ 3000 1 4000 5000

(Joins sheet 32)

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 44)

2 210 000 FEET

635 000 FEET

620 000 FEET

2 185 000 FEET

Indian Creek

32 18 7 42 33 17 8

(Joins sheet 33)

2 210 000 FEET

635 000 FEET

(Joins sheet 38)

(Joins sheet 40)

(Joins sheet 45)

2 235 000 FEET

620 000 FEET

Bluff Creek

Bluff Creek

195 194 193 192 164 165 166 167 161 160 159 158 133 134 135

N

2 Miles 1

10000 Feet 5000 0

Scale 1:24000

1 ¼ ½ ¾ 1

5000 4000 3000 2000 1000 0


(Joins sheet 34)
2 265 000 FEET
635 000 FEET
(Joins sheet 39)
620 000 FEET
2 240 000 FEET
(Joins sheet 46)
(Joins sheet 41)
N
2 Miles
10000 Feet
Scale 1:24000
129
100
97
128
101
96
127
126
41
Bluff Creek
Deer Creek
Red
Miami
(county seat)
Miami-Roberts County Airport
TOPEKA
ATCHISON
SANTA

ROBERTS COUNTY, TEXAS — SHEET NUMBER 41

(Joins sheet 35)

2 270 000 FEET

635 000 FEET

(Joins sheet 40)

(Joins sheet 47)

2 295 000 FEET

620 000 FEET

Deer Creek

Red

TOPEKA

ATCHISON

SANTA FE AND

Washita River

HEMPHILL COUNTY

13 10 14 9 15 8 16 7 32

60

41

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 42

42

N

Scale 1:24000

2 Miles 1 0 1 2

10000 Feet 5000 0 1000 2000 3000 4000 5000

(Joins sheet 36)

2 150 000 FEET

615 000 FEET

600 000 FEET

2 125 000 FEET

(Joins sheet 48)

(Joins sheet 43)

COUNTY

HUTCHINSON

West Fork Reynolds Creek

Reynolds Creek

215 216 217 218 197 196 195 190 191 192 171 170 169 164 165 166

2 155 000 FEET

615 000 FEET

(Joins sheet 37)

(Joins sheet 42)

(Joins sheet 44)

(Joins inset, sheet 48)

2 180 000 FEET

600 000 FEET

N

2 Miles

10000 Feet

Scale 1:24000

Creek

Creek

Chicken

Tallahone

145

138

119

112

144

139

118

113

87

143

140

11

91

88

(44)

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0 1000 2000 3000 4000 5000

(Joins sheet 38)

2 210 000 FEET

615 000 FEET

(Joins sheet 43)

600 000 FEET

2 185 000 FEET

(Joins inset, sheet 49)

(Joins sheet 45)

67 60 41 34 16 9 202

66 61 40 35 203

65 62 39 36 14 11 204

Bluff Creek

282

(Joins sheet 39)

2 210 000 FEET

615 000 FEET

(Joins sheet 44)

Creek

Bluff

202

101

168

157

136

203

190

169

156

137

204

189

170

155

138

CREEK

DEER

SANTA FE

AND

TOPEKA

ATCHISON

RED

(Joins sheet 46)

(Joins sheet 49)

2 235 000 FEET

600 000 FEET

45

N

2 Miles

10000 Feet

Scale 1:24000

1 0 1 5000

¼ 0 ¼ 1000

½ ½ 2000

¾ ¾ 3000

1 4000

5000

46

N

Scale 1:24000

2 Miles 10000 Feet

1 5000 0 1000 2000 3000 4000 5000

(Joins sheet 40)

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 50)

2 265 000 FEET

615 000 FEET

600 000 FEET

2 240 000 FEET

Miami (county seat)

Deer Creek

Red

Santa Fe

Topeka and Atchison

125 104 93 42

124 105 92 73 43

123 106 91 74 59 44

122 107 90 75 58

(Joins sheet 41)

2 270 000 FEET

615 000 FEET

(Joins sheet 46)

Washita River

COUNTY

HEMPHILL

(Joins inset, sheet 50)

2 295 000 FEET

600 000 FEET

47

N

2 Miles

10000 Feet

Scale 1:24000

ROBERTS COUNTY, TEXAS — SHEET NUMBER 48

48

N

2 Miles

10 000 Feet

1

5000

Scale 1:24000

0 0 1 000 2 000 3 000 4 000 5 000

(Joins sheet 42)

2 150 000 FEET

595 000 FEET

(Joins inset)

590 000 FEET

2 125 000 FEET

HUTCHINSON COUNTY

CARSON COUNTY

GRAY COUNTY

(Joins sheet 43)

2 180 000 FEET

(Joins upper right)

Tallahone Creek

(Joins inset, sheet 49)

2 155 000 FEET

ROBERTS COUNTY, TEXAS — SHEET NUMBER 49



N

2 210 000 FEET

2 235 000 FEET

2 185 000 FEET

2 210 000 FEET

595 000 FEET

590 000 FEET

(Joins sheet 45)

(Joins inset)

(Joins sheet 50)

(Joins sheet 44)

(Joins inset, sheet 43)

(Joins upper left)

CREEK

SANTA FE

TOPEKA

ATCHISON

RED DEER

AND

205

188

171

154

139

206

187

172

153

140

222

64

63

38

37

13

12

49

48

25

24

1

GRAY COUNTY

2391

282

60

2 Miles

10000 Feet

5000

Scale 1:24000

0

1000

2000

3000

4000

5000

50

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

2000 ½

3000

¾ 4000

1 5000

(Joins sheet 46)

2 265 000 FEET

595 000 FEET

(Joins sheet 49)

(Joins inset)

122 107 90 75 58 121

748 1268

GRAY COUNTY

(Joins sheet 47)

2 285 000 FEET

(Joins upper right)

590 000 FEET

580 000 FEET

HEMPHILL COUNTY

WHEELER COUNTY

GRAY COUNTY

2 270 000 FEET

2 240 000 FEET